DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

APRIL, 1942

PRINCIPAL CONTENTS OF THIS NUMBER

For Complete Classified Contents, See Page 244

The Railroads Tackle Their Biggest Job 125
Building Huge Locomotives to Help Win the War *By R. B. McColl* 126
Thousands of Coal Cars to Keep Munitions Plants Running *By Charles O. Herb* 134
Producing Westinghouse Equipment for Electric and Diesel Locomotives . . . *By R. H. Timmons and J. A. Dorsner* 142
Keeping the New York Central's 4000 Locomotives in Running Order . . . . *By Charles O. Herb* 150
Diesel-Electric Switchers for War-Production Industries *By F. H. Craton* 158
Baldwin Locomotives for Long Hauls and Switching Service *By Amos G. Cole* 166
The Santa Fe Prepares for Wartime Traffic 172
Timken Tapered Roller Bearings Speed up Railway Transportation . . . . *By Walter C. Sanders* 174
Stainless-Steel Trains for Increased Passenger Traffic . . . 180
B & O Concentrates Production in One Shop *By W. S. Eyerly* 184
Make Use of the Experience and Skill of Older Men to Speed War Work . . . . *By George T. Trundle, Jr.* 189
Editorial Comment 190
A Typical American Free Enterprise Celebrates Its Fiftieth Anniversary 194
What the Product Designer Should Know About Plastics *By Erik Furholmen* 199
Successful Method of Putting Idle Equipment to Work on Munitions 204
Management and Labor Must Win the War through Production 207

DEPARTMENTS

Ingenious Mechanical Movements 191
Materials of Industry 208
Shop Equipment News 213

Small in size and simple in design, the Airplane Rivet, nevertheless, has been the subject of extensive experimentation and development. An article in May MACHINERY will give a step-by-step description of the manufacture of this important detail in aircraft dependability. Another article will cover special equipment in aircraft factories. The conversion of a linoleum plant to the manufacture of shells and aircraft wing-tips is the subject of another unusual and instructive article of value to manufacturers and engineers engaged in plant conversion.

Volume 48
Number 8

Product Index 404-425
Advertisers Index 427-428

TOTAL DISTRIBUTION
20,925

PUBLISHED MONTHLY BY
THE INDUSTRIAL PRESS
148 Lafayette Street New York

ROBERT B. LUCHARS .... *President*
EDGAR A. BECKER *Vice-pres. and Treasurer*
ERIK OBERG .... *Editor*
FRANKLIN D. JONES.....*Associate Editor*
CHARLES O. HERB.......*Associate Editor*
FREEMAN C. DUSTON....*Associate Editor*

BRIGHTON, ENGLAND:
MACHINERY, 17 Marine Parade

SUBSCRIPTION RATES: United States and Canada, one year, $4; two years, $7; three years, $8 (for Canada add 25 cents per year for war tax); foreign countries, $7 a year. Single copies 40 cents, except this special number, which is $1. Changes in address must be received by the fifteenth of the month to be effective for the forthcoming issue. Send old as well as new address.

Entered as second-class mail matter, September, 1894, at the Post Office, New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America. Member of A.B.P. Member of A.B.C.

* With 19 patented features, Lodge & Shipley lathes were doing work of outstanding accuracy in 1892.

BACK in 1894, at a time when feeds were dependent on belt-driven step pulleys, and threads determined by loose transposing gears, Lodge & Shipley lathes were equipped to give a wide range of threads and feeds—without removing a single gear. The Quick Change method was a milestone in lathe development.

MACHINERY

NEW YORK, APRIL, 1942

Volume 48
Number 8

The Railroads Tackle Their Biggest Job

AMERICA'S vast railroad systems are indispensable to our Victory Program. Upon them falls the enormous task of carrying raw materials from mines and mills to industrial plants, and transporting the finished war products to Army and Navy bases on this continent or to seaports for shipment to a multitude of fighting fronts. Upon the railroads, too, falls the job of hauling large bodies of troops between distant points and of keeping our armed forces and civilians supplied with the necessities of life.

The railroads have thus far kept pace with wartime requirements. However, as industrial production expands to unprecedented proportions, they will need considerably more rolling stock. Approximately 100,000 new freight cars and close to 600 new locomotives were on order on January 1 for delivery during 1942. Steel and other raw materials must be made available for producing this equipment. With the required materials, modern metal-working methods, such as those described in MACHINERY'S Railroad Production Number, will insure success for the biggest job in railroad history.

Building Huge Locomotives

The American Locomotive Co. is Busily Engaged in Producing Steam and Diesel-Electric Engines for Carrying Munitions, Troops, and Food from Coast to Coast

By R. B. McCOLL, Vice-President in Charge of Manufacturing

TWENTY monster locomotives—believed to be the biggest and most powerful in the world—have been built in recent months by the American Locomotive Co., Schenectady, N. Y., for hauling heavy freight trains over the Rocky Mountain grades of the Union Pacific Railroad at sustained speeds of 70 miles an hour. Since these engines and many others being built by this company are vitally necessary for transporting the munitions and food supplies of our armed forces, as well as the troops themselves, they may be considered almost as important to victory as military tanks, gun carriages, bombs, and other war products.

The Union Pacific locomotives, as may be seen from the illustration below, are of the mallet type, which really comprises two engines in one, there being two complete sets of driving wheels on each locomotive which are driven from independent sets of cylinders and valve gears. The Union Pacific engines have sixteen driving wheels, arranged in groups of eight each, and in addition, four truck wheels under

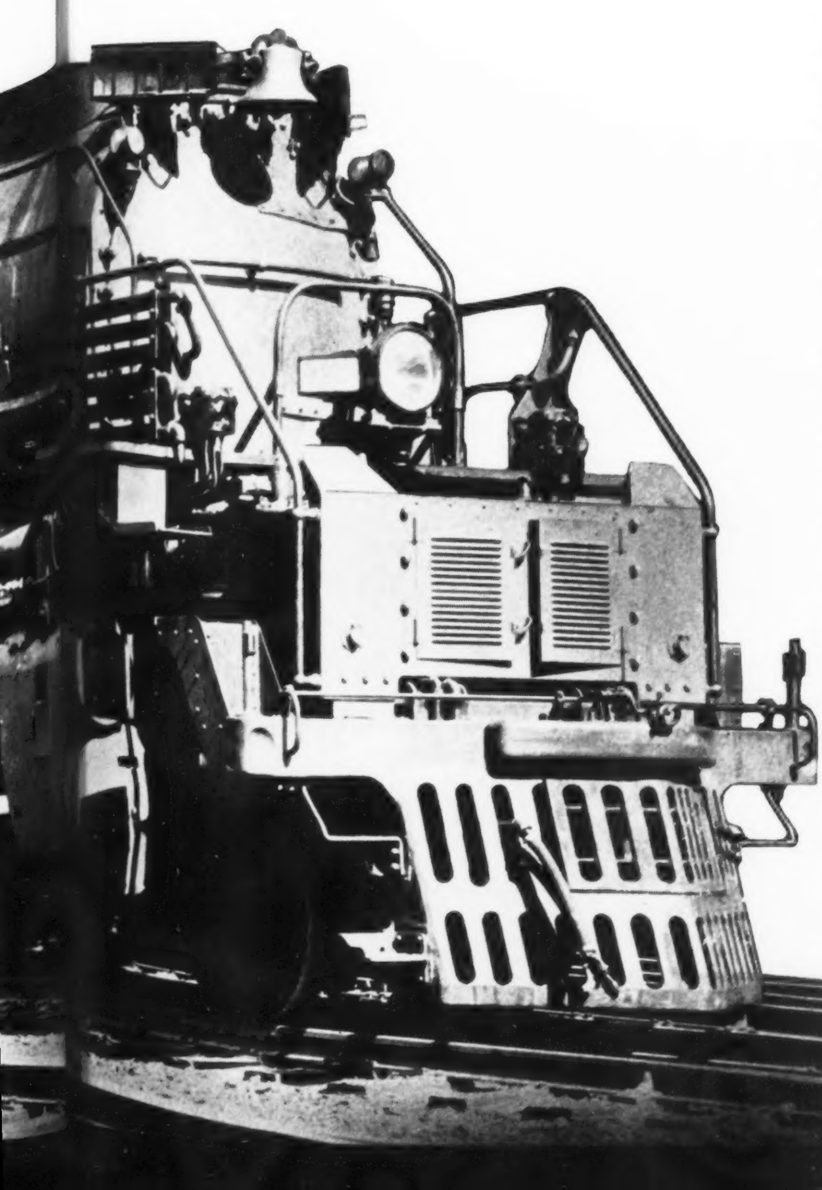
Mallet Type Steam Locomotive Having a Total Weight of 762,000 Pounds—Twenty of These were Recently Delivered to the Union Pacific Railroad

s to Help Win the War ★

the front cylinders and four truck wheels under the firebox, making a total of twenty-four wheels. The over-all length of one of these locomotives, together with its tender, is 132 feet 10 inches. The weight of the locomotive by itself is 762,000 pounds, and its maximum tractive power is over 135,000 pounds. The driving wheels are 68 inches in diameter. Incidentally, each of these engines costs $250,000, the complete order amounting to $5,000,000.

Methods typical of those followed in building these monsters of the rails will be outlined in this article. While the American Locomotive Co. also builds Diesel-electric locomotives, only operations in the building of steam locomotives will be described here.

It will be evident that equipment of unusual size must be employed in building such large products. In the boiler shop, there are two bull riveting machines with columns so high that entire boilers can be riveted while suspended vertically from a crane. The hammer and anvil of these riveters are 23 feet 6 inches above the floor. During riveting, the boiler can be readily swung around to present the different rivets to the riveting hammer. In Fig. 1, the boiler at the left is being carried into position in one of these bull riveters, while another is seen at the right in the riveting position.

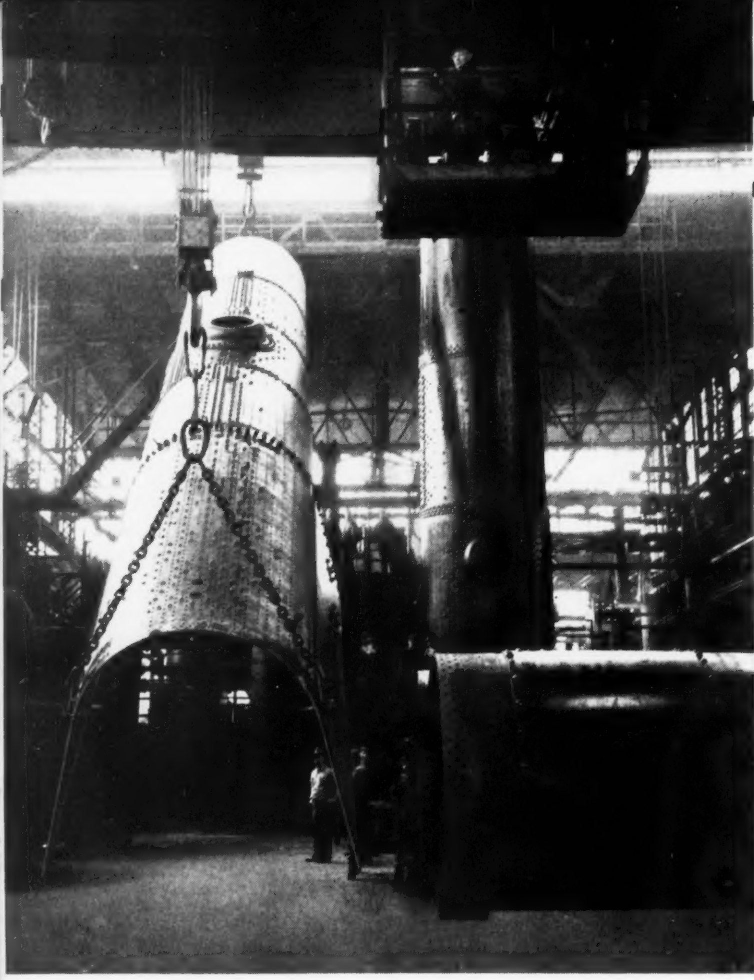


Rolls 25 feet long, built by the Baldwin Southwark Corporation, are applied as illustrated in Fig. 2 for rolling smokeboxes, boiler and firebox shells, and crown and roof sheets. This machine has a capacity sufficient for handling all boiler work of this type, and has been used in rolling plate as thick as 1 1/4 inches. The top roll is 32 inches in diameter, and the bottom rolls are 20 inches in diameter.

After a plate has been rolled into a shell as shown, the complete bearing unit for the top roll in the housing, seen in the foreground, is slipped out of the housing by the use of a crane and carried to one side. The entire upper housing member at this end, which is pivoted on heavy trunnions near the floor, can then be swung down into a horizontal position by the operation of a hydraulic cylinder. This enables the boiler shell to be withdrawn endwise from between the rolls. After the removal of a shell, the housing is again swung into the position shown by hydraulic action, and the top roll bearing is assembled into the housing.

A cold sawing machine equipped with a circular saw 10 feet in diameter is used in cutting ingots up to about 3 feet in diameter into required lengths. A general view of this machine is illustrated in Fig. 4, while the close-up view, in Fig. 5 shows the saw cutting through an axle billet about 2 feet in diameter. Eighty cutters 1 1/4 inches wide are mounted in slots around the saw blade. These cutters are alternately of square-nose and round-nose types.

In general, the saw is run at a speed of one revolution in one minute twenty seconds, or approximately at 23 1/2 surface feet a minute. A feed of about 5/16 inch per revolution is customary. The saw is mounted on a heavy slide, as seen in Fig. 4, which is moved by hydraulic power along the bed of the machine. The work is clamped in a large serrated V-block.



BUILDING HUGE LOCOMOTIVES

Fig. 1. Bull Riveters with a Reach of More than 23 Feet Facilitate Riveting the Locomotive Boilers

A Newton vertical milling machine is shown in Fig. 3 engaged in profile milling the outside surfaces of two radius links at one time. The outline of the links is first scribed and marked with a prick-punch for use as a guide by the operator as he adjusts the work by means of the table controls to feed it past the cutter. Longitudinal, crosswise, and circular table movements are obtainable. The operation consists of finish-milling with a cutter 5 inches in diameter by 6 inches in length. Stock from 1/4 to 3/4 inch deep is removed. Later the same surfaces are ground, mainly for appearance.

A Mattison surface grinding machine engaged in grinding the bearing block at one end of a large side-rod is illustrated in Fig. 7. The side-rod is nearly 10 feet long. When the side-rods reach this operation, the bearing blocks have been milled to within 1/16 inch of the finished thickness, the practice being to grind off about 1/32 inch per side to attain the finished dimension within 0.002 to 0.003 inch. This amount of stock is later removed by buffing. The table of this machine is 18 feet long, and the bed 36 feet long. When new, the grinding wheel is 20 inches in diameter by 5 inches face width. It has a maximum lateral movement of 25 1/2 inches.

Fig. 6 shows a later operation on the side-rods—that of boring out the main crankpin bearing on two rods. This operation is performed on a large Niles double-head boring mill, the heads of which are mounted on a long cross-rail at the back of the bed, so that they can be moved the required distance apart for simultaneously boring opposite ends of the same rod or one end on different rods. The cutter-heads are offset on the machine spindles to permit the cutters to be positioned at different radii with respect to the center of the spindles, ad-

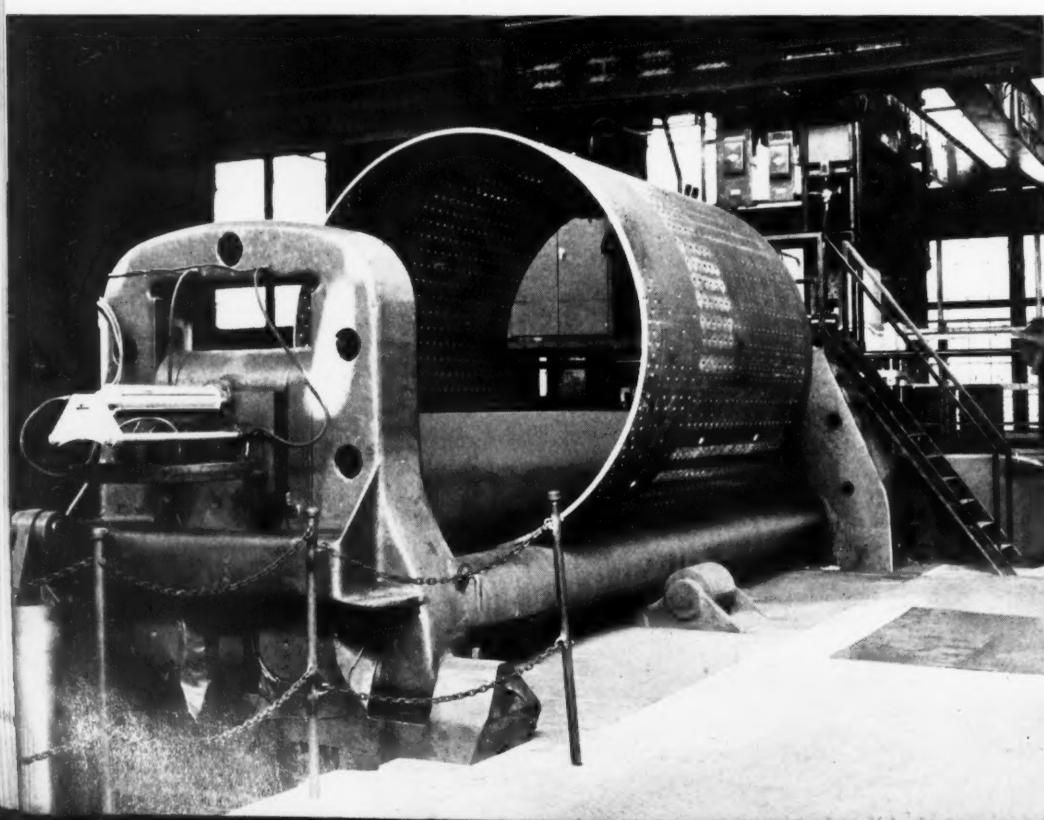


Fig. 2. Twenty-five Foot Rolls Employed in Rolling Smokeboxes, Boiler and Firebox Shells, and Crown and Roof Sheets from Flat Plates

★

Fig. 3. Profile Milling Two Locomotive Radius Links in Accordance with a Scribed Outline

justments being made by means of slides. The maximum sidewise adjustment is 2 inches. Cutter-heads of large or small diameter are used as required, it being the practice to also bore the knuckle-pin bearing holes in the side-rods on this machine.

The flared "tin-pan" seen surrounding the cutter-head in the foreground just above the cutter is a container for coolant, which is delivered to it by a hose. The coolant is directed on the cutter nose through a spout soldered to the tin container.

This boring operation consists of semi-finishing after solid blocks of stock have been trepanned from the side-rods by employing heads equipped with three cutters each, which are held vertically. First a 1 3/4-inch hole is drilled through the rod to receive a pilot bar in the center of the trepanning head. In trepanning, the practice is to cut half way through the rod and then turn it over for trepanning the other half.

One of the final operations on the side-rods consists of grinding the steel crankpin bushings accurately to size after they have been assembled in the rods, and also of grinding the knuckle-pin bearing on certain types of rods. These operations are performed on Micro grinding machines set up similarly to the operation seen in Fig. 8. In grinding a crankpin bushing, one of the projecting ends of the bushing is seated on a hardened and ground ring of the fixture, so as to insure close concentricity between the inside and outside of the bushing. The practice is to grind the crankpin bushings to specified dimensions within plus or minus 0.001 inch. The specified dimensions on the rod illustrated are 11.284 and 10.281 inches.

Huge machines with three double-housing structures for carrying the tool-heads are used

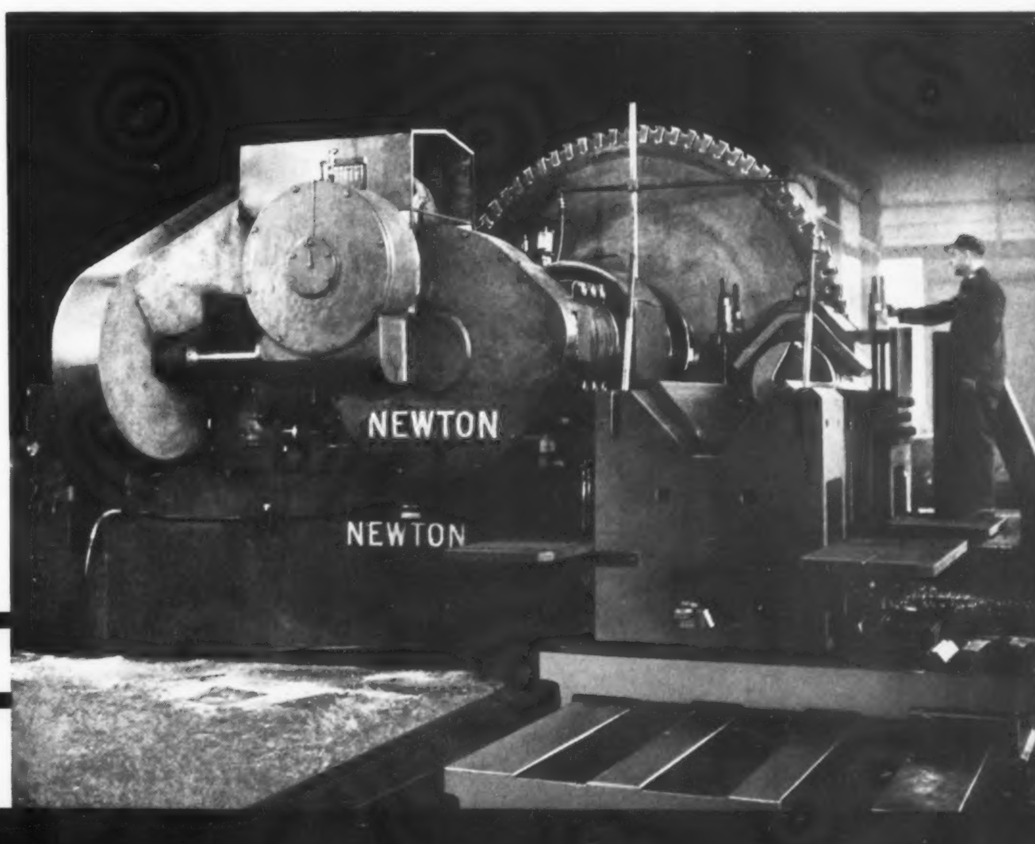


Fig. 4. Hydraulically Fed Cold Sawing Machine with Saw 10 Feet in Diameter, Used for Cutting Ingots up to About 3 Feet in Diameter

★

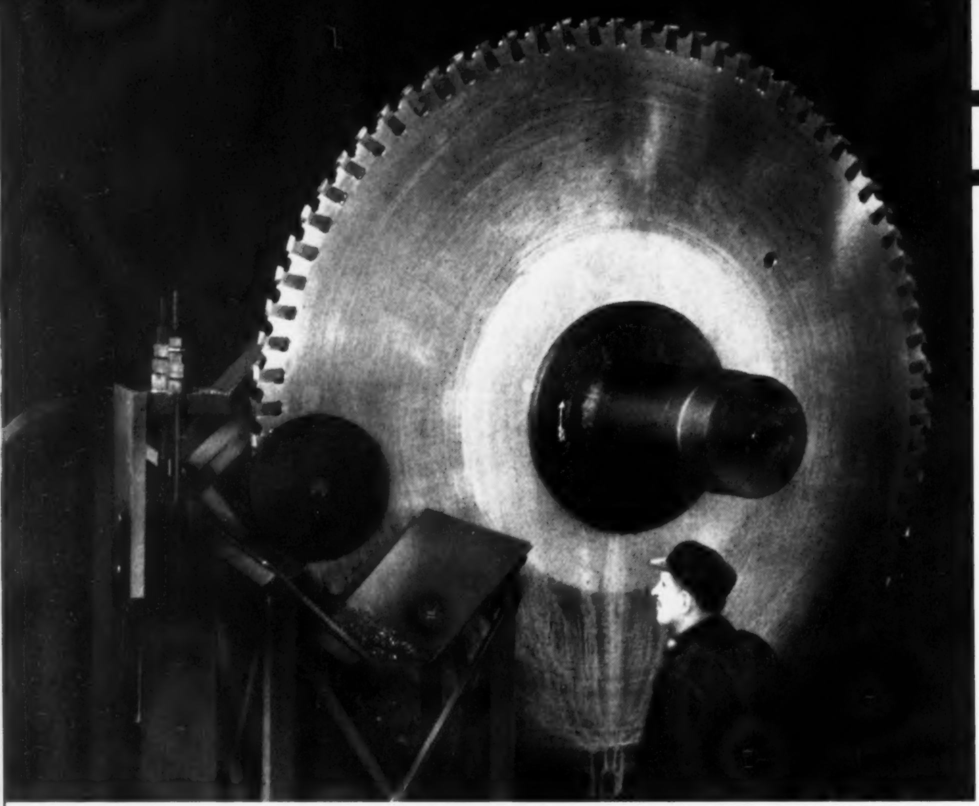


Fig. 5. (Left) Close-up View of the 10-foot Diameter Saw Blade of the Cold Sawing Machine Shown in Fig. 4

Fig. 6. (Below) Duplex Type of Machine Employed for Boring the Opposite Ends of Connecting-rods at the Same Time or One End on Two Different Rods

in slotting locomotive frames of the built-up type. In the operation shown in Fig. 9, three slotting heads of a Betts machine are engaged in machining the pedestal fits of eight frames, stacked one upon the other, although only two slotting heads are visible. The bed of this machine is 66 feet long.

In slotting the 4 1/2-inch thick frames, Carboloy cutters take a cut 3/4 inch deep in roughing. They are also used for the lighter finishing cuts. As one side of each pedestal must be finished at an angle relative to the center line of the pedestal, the slotting heads used for machining that side of the pedestal are adjusted to the required angle with respect to a straight line across the bed of the machine.

In addition to the pedestal fits, the various frame openings provided between the pedestals for lightening purposes are finished on this machine. The tool-head housings are adjustable along the bed by means of lead-screws at the front and back of the machine.

A new Libby turret lathe is seen in Fig. 10 tooled up for the production of four spring-rigging bushings of the type seen lying on top of the turret. Bar stock 5 inches in diameter is used. After the stock has been fed forward to a stop on the turret, it is rough-turned the length required for four pieces by employing a Kennametal-tipped tool mounted on the cross-slide toolpost. Stock is cut off to a depth of 3/8 inch at a speed of 225 R.P.M. (approximately 300 feet a minute), with a feed of 0.032 inch per revolution.

Upon the completion of the rough-turning cut, the stub drill seen on the turret is used to start drilling into the end of the bar. At the same time, the parting tool on the cross-slide toolpost

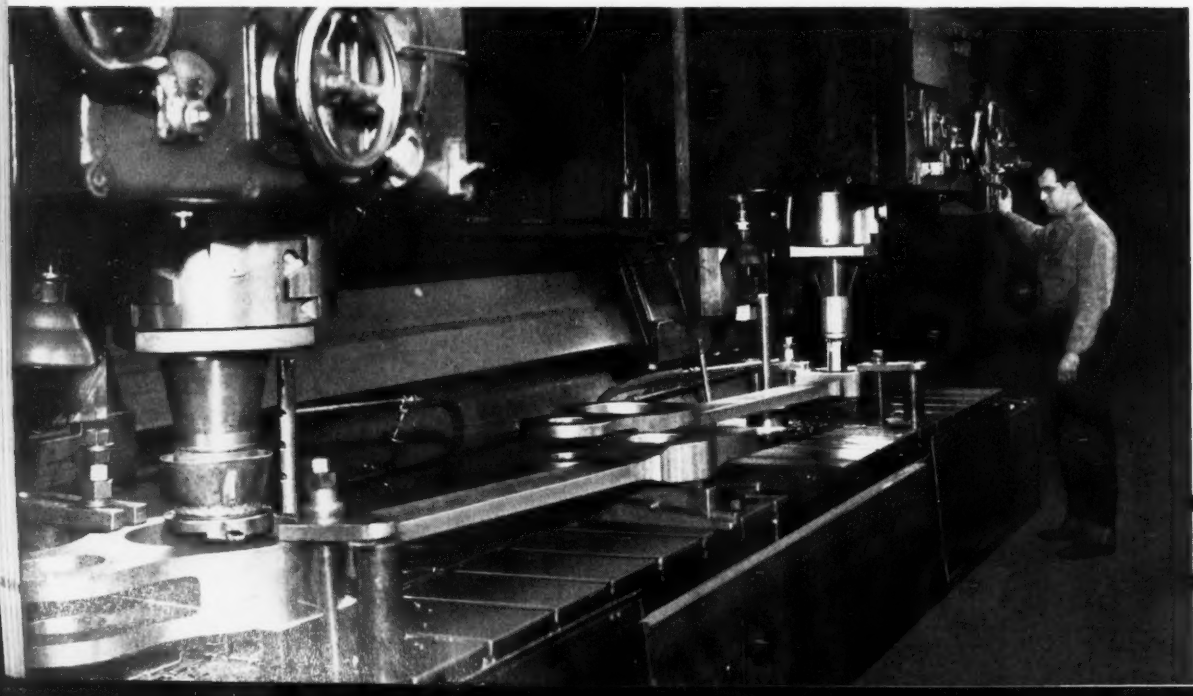


Fig. 7. (Right) Surface Grinding Operation on the Bearing Blocks at the Ends of a Large Locomotive Side-rod

Fig. 8. (Below) Grinding the Large-diameter Crankpin Bushings in a Side-rod to the Specified Dimension within Plus or Minus 0.001 Inch

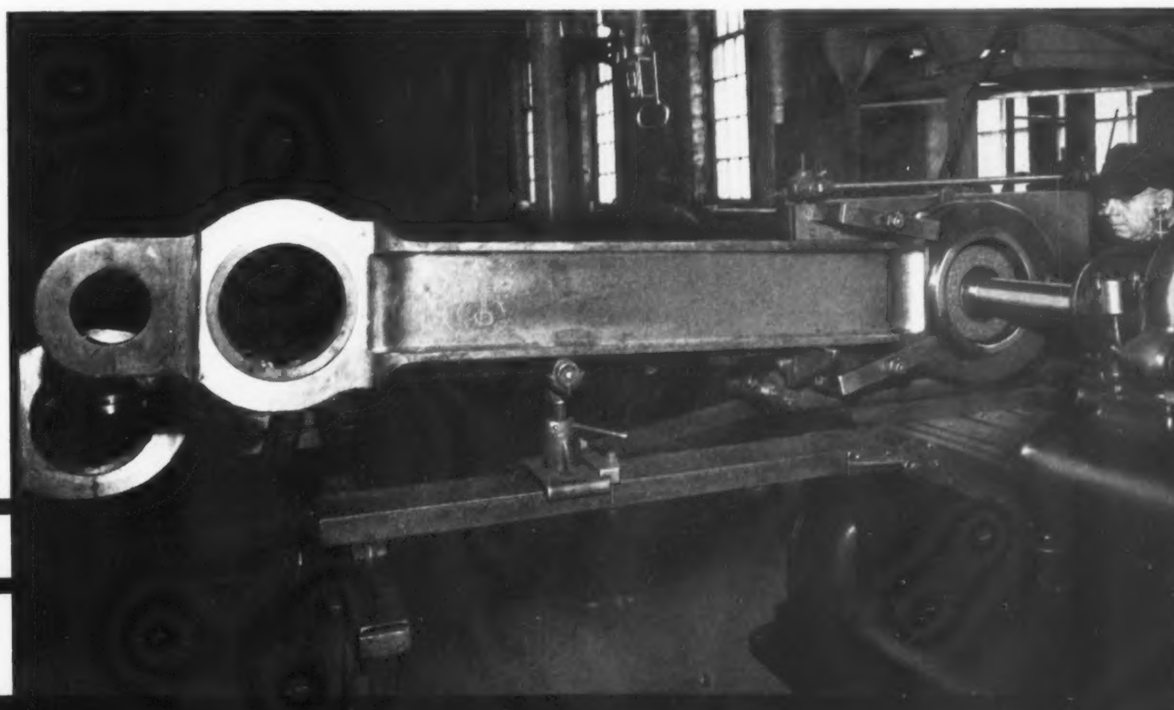
cuts four annular grooves at different points along the stock to start separating the four pieces. Then the Kennametal tool on the cross-slide toolpost is again used to rough-turn the portions between the flanges of the parts. In taking these cuts, the operator readily sets the tool by observing the graduations on the lead-screw dial when he revolves the lead-screw. This cut is also taken to a depth of 3/8 inch per side, but at a speed of 100 R.P.M., with a feed of 0.018 inch.

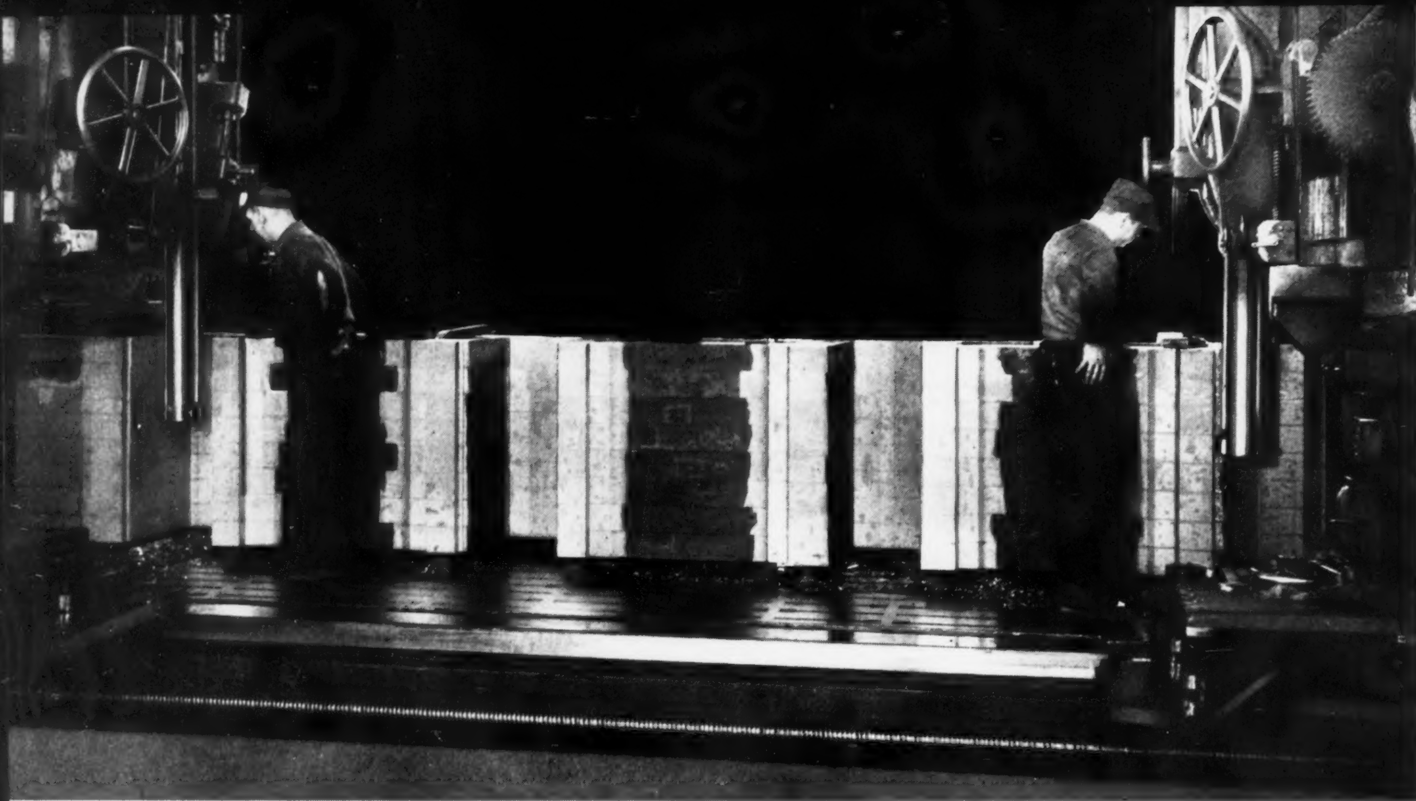
While this cut is in progress, a 2 17/32-inch drill on the turret drills the stock for a depth of 10 inches. Then a blade type form cutter on the cross-slide, which is the complete width of one piece, is used to finish-form all four pieces, one at a time. After two pieces have been finish-formed, they are cut off by the parting tool. Then the drill is used again for drilling to a depth of about 10 inches in the remaining two pieces. The finished pieces are 4 3/4 inches long by 4 3/4 inches maximum diameter.

After the crankpins have been assembled in the driving wheels and the wheels mounted on their axles, the crankpins are finish-turned and then burnished on Niles quartering machines. Fig. 11 shows a typical burnishing operation. It will be seen that the operation is performed by two hardened steel rolls, mounted diametrically opposite each other on a head that can be fed along the crankpin. The spindle of the machine is hollow, so that it, too, can be advanced along the crankpin.

The burnishing rolls compress the surface metal of the crankpin approximately 0.0005 inch to provide a hard smooth surface that guards against the development of any cracks from tool marks. The two diameters of the crankpin seen

★





are burnished, one diameter being 9 inches and the other 10 inches. The fillet on the shoulder between the two surfaces is also burnished, the burnishing rolls being rounded on one side to correspond with the radius of the fillet. The burnishing rolls are 4 inches in diameter by about 1 inch wide. They are mounted on roller bearings to insure free running.

In the operation, the wheel assembly revolves on centers, but in addition, the treads of both wheels are supported on rollers mounted on the machine bed. In finish-turning the crankpins prior to the burnishing operation, single-point cutters are mounted on the tool-head in a similar manner to the rolls. The quartering machines are of the double-end type so that the crankpins on the opposite ends of a wheel set are turned or burnished at the same time.

Holes for the long bolts used in clamping eccentric cranks to main crankpins are drilled with the Cincinnati-Bickford radial drilling machine seen in Fig. 12. The eccentric crank is accurately mounted in the fixture by seating the two bores over hardened and ground plugs, which insure that the bolt-holes will be drilled closely parallel to vertical center lines passing through both bearings. These holes are reamed when the eccentric cranks are fitted to the engines on which they are to be used.

An Acme universal turret lathe engaged in producing sleeves to be brazed to the ends of piping for use as couplings is shown in Fig. 13.

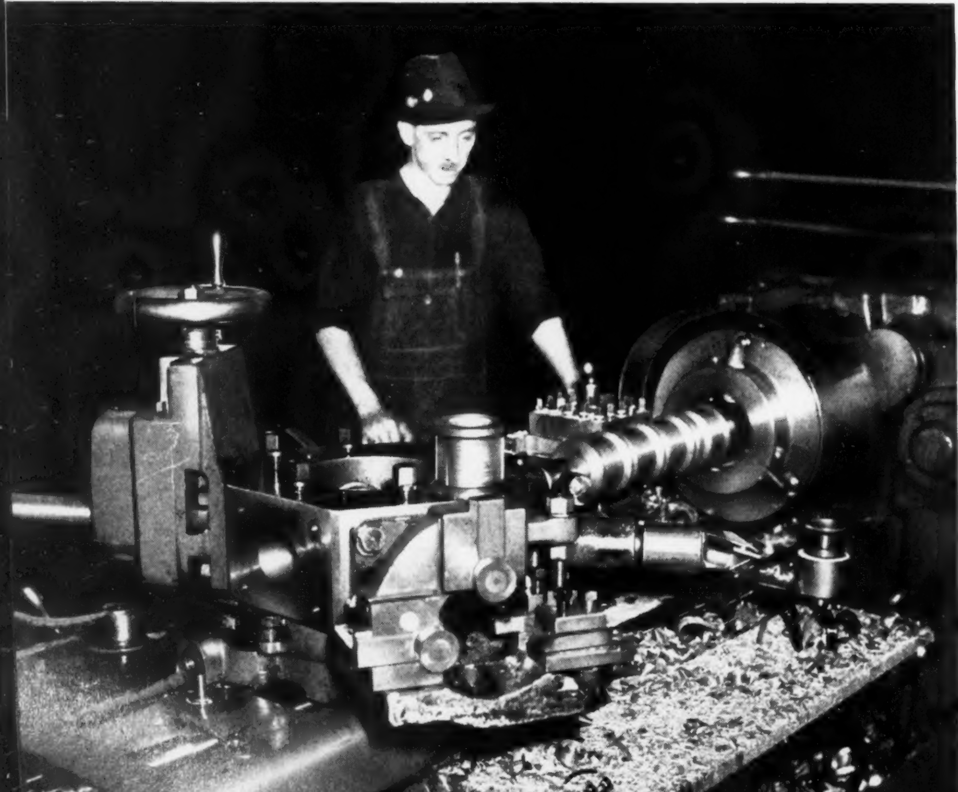
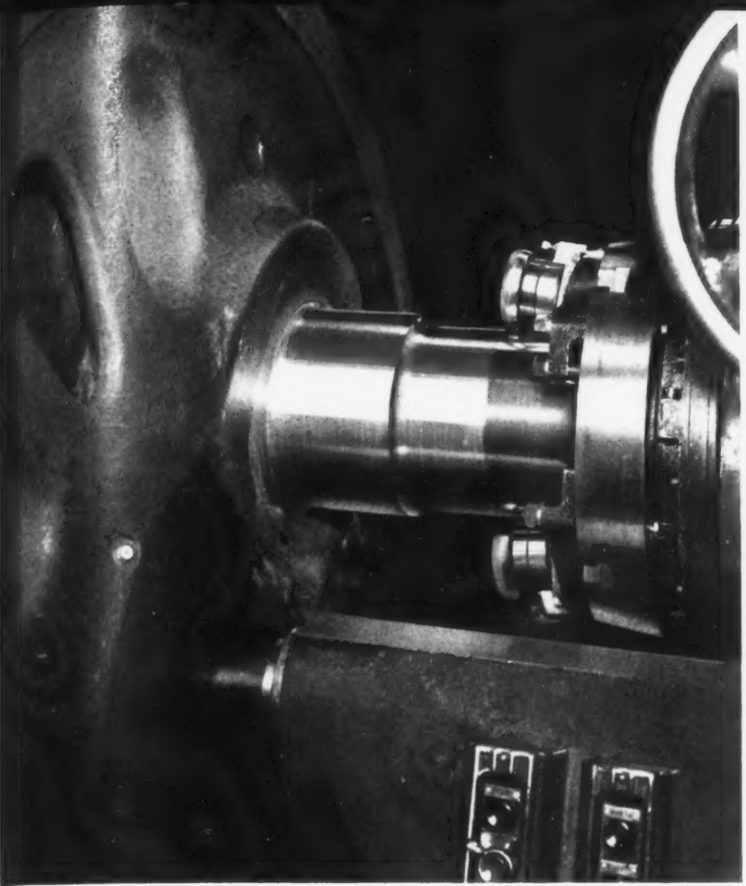
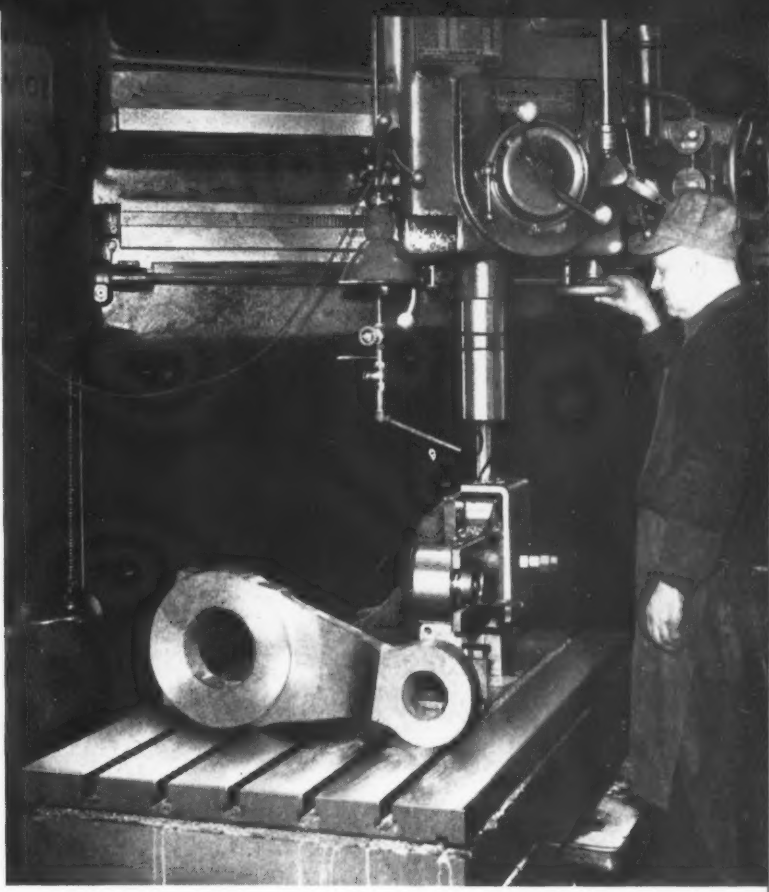


Fig. 9. (Above) Triple-housing Slotting Machine being Used for Simultaneously Planing a Stack of Eight Locomotive Frames at Three Different Points along the Frames

Fig. 10. (Left) Operation in which Four Spring-rigging Bushings are Produced with Each Forward Feed of the Bar through the Headstock





The raw material is 3 3/4-inch diameter bar stock. The first step in the operation consists of centering the end of the bar with a tool on the turret to facilitate drilling. Then the 2 11/16-inch diameter drill seen in operation is fed into the work for a length of 4 inches, which is sufficient for two parts; the stock, however, has been fed out far enough for cutting four pieces.

While drilling is in progress, a rough-turning cut is taken by a tool on the front of the cross-slide to a diameter of 3 7/16 inches, which is the diameter of a flange that will be left at one end of the finished piece. Then the same tool turns the outside diameter to 3 1/16 inches, except where shoulders are left on the successive pieces, as shown by the finished part that lies on top of the turret. A second tool on the toolpost is fed toward the right to accurately face one side of each flange.

The stock is next reamed to a diameter of 2 3/4 inches for a depth of 4 inches. Then a form tool on the turret chamfers and tapers the end of the part on the inside. A third tool on the cross-slide next cuts off two pieces. The stock for the remaining two pieces is then drilled, reamed, and cut off.

Fig. 11. (Above Left) Burnishing the Crankpin of a Driving Wheel on a Quartering Machine

Fig. 12. (Above Right) Drilling Holes for the Clamping Bolts through Eccentric Cranks

Fig. 13. (Right) Turret Lathe Set-up in which Sleeves are being Produced from Solid Stock to be Brazed to Piping for Use as Couplings

Thousands of Coal Cars
Munitions Plants Running

Mass Production Methods Turn out Thirty-five Hopper Cars a Day in One Shop of the Nation's Largest Freight Car Building Company

By CHARLES O. HERB

★

THE tremendous industrial expansion resulting from our Victory Program has placed an almost insuperable burden upon the railroad systems of the nation. This abnormal activity is taxing many railroads to the limit of their hauling capacity. The situation would have been difficult enough if it had come after a period of prosperity, during which the railroads could have built up their rolling stock to a high load-carrying capacity. Coming, as it has, after a long depression that was especially hard on the railroads, many lines find themselves in need of new freight, tank, and coal cars to transport fuel and ore from mines to mills, steel from mills to munitions factories, and finished products to Army and Navy establishments and civilian consumers.

This wartime problem makes car building only slightly less important than the manufacture of actual implements of warfare. Without adequate transportation facilities, our Victory Program would soon bog down. Car shops are, therefore, working day and night to provide these facilities.

The American Car and Foundry Co. is the largest American builder of coal and freight cars, operating shops in a number of cities for turning out these types of rolling stock. Today this concern is building more cars per day than ever before, in spite of the fact that it has also established an enviable record in the production of war materiel.

One of the busiest A.C.F. car shops is the one located at Huntington, W. Va., which is at present turning out from thirty to thirty-five hopper coal cars per day for the Chesapeake & Ohio Railway on two orders of one thousand cars each. These cars are of fifty tons capacity and have a specified weight of 41,800 pounds. They are 33 feet 11 3/4 inches long from coupler to coupler, and are 10 feet 4 inches high above the tracks. In addition to these orders, this shop has recently completed several hundred cars for other railroads, and has a large backlog of orders on hand.

Production methods in this car-building shop are similar to those employed by the automobile industry in that the truck wheels and axles move along machine lines that converge at a large horizontal hydraulic press, which forces the wheels on the axles at pressures of from 80 to 90 tons. These assembled wheel units are then rolled to a machine which grinds the treads concentric with the axle journals to a relatively close tolerance. From this point, the wheel units are rolled to a short assembly line, where the complete car trucks are put together. The trucks are moved from these lines to car erection or assembly tracks in the main fabrication shop.

In the fabrication shop, practically all plates

to Keep

and sheets required in constructing the coal cars are sheared, punched, formed, etc., at one end of the building. The individual structural members are then transferred by crane to various points in the shop where the different sections, such as the bolsters, car sides and ends, hopper doors, and so on, are riveted together in sub-assembly stations served by small cranes that operate on steel girder superstructures, and also by 10-ton overhead cranes which span the entire 90-foot width of the shop.

The sub-assembly stations are located along the center of the building and along one side. As the sub-assemblies are completed, they are transferred across the shop to two erection tracks which parallel each other. These tracks extend approximately 300 feet from one end of the building. The erection of cars commences at one end of one track, and is completed at the same end of the second track.

The principal car member not fabricated in this shop is the center sill, which is built up in an adjacent building by arc-welding two steel Z-shapes together along the top and riveting striker or coupler castings in each end of the welded member. When the center sills are delivered to the fabrication shop, they are taken to a sub-assembly station, where two bolsters have been set up in fixtures parallel to each other and the required distance apart. These fixtures are necessary because it is vitally important that the sills be riveted in the exact center of the bolsters. After the center sill has been fitted into the bolsters, the sill and bolsters are riveted into one unit. A general view of this sub-assembly station is shown in Fig. 2.

This center sill and bolster assembly is then moved by a crane to a large pit located opposite the first station of the preliminary erection line. Here the center sill assembly is turned upside down to enable rivets to be driven in the under side by the application of a squeeze riveter. The assembly is then placed on dummy trucks on the preliminary erection track for convenience in moving it from station to station along this track.

Every eighteen minutes all cars on both the preliminary and final erection tracks are moved the distance of one station. This is accomplished by using motor-driven car-pullers or winches which pull steel cables that are fastened to the individual coal cars. Two minutes before a car transfer is to be made, the shrill tone of a siren informs every workman in the shop of the fact. When the time actually arrives for the transfer, several sirens blow all the time the cars are in motion, to warn workmen of the danger of getting in the way of moving cars and also to notify the men in the sub-assembly stations and the crane operators that it is time to transfer

a new sub-assembly to each station along the erection lines. No one in the shop can fail to know that a car transfer is being made, because the sirens are so loud that, as one man expressed it, "There is a New Year's celebration every eighteen minutes."

When the sill and bolster assembly reach the second station along the preliminary erection track, the inside and outside hoppers are fitted in place. In successive stations, the longitudinal hood that covers the center sill, the cross-ridge gussets, end sills, diagonal braces, door-closing angle-irons, etc., are all riveted to the structure. This approximately completes the under side of the car. All riveted holes are reamed by applying pneumatic hand tools before the rivets are inserted. The rivets are heated in Berwick induction electric heaters.

These car assemblies are next lifted by a crane and transferred to the first station of the final erection track at the point where the assembled trucks arrive in the fabrication building. Here they are lowered on the trucks and proper connections made. In this station also, the draft gear or automatic couplers are assembled to the ends of the center sill.

The car is then moved to the second station of this line, where the floors, cross-ridges, and hopper doors are fitted into place. In the third station, all rivet holes on these various units are reamed. In the fourth station, the rivets are driven over the complete floor unit by pneumatic-hammer gangs. The ends are fitted to the cars in the fifth station, these sections coming to the erection track in one piece from a sub-assembly station along the opposite side of the building. The hand brake rigging is also assembled at this point.

In the sixth station, the sides are hung on the car. They also come to the erection line in one piece. In the seventh station, the sides and ends of the car are riveted, after the holes have been reamed. In the eighth station, an overhauling gang of riveters removes any faulty rivets that have been rejected by the inspectors and redrive rivets. The car then moves into an outside shed, where welders close up several cracks at the points where the steel sheets come together, so as to make the car "coal-tight."

From this point on, the cars are taken to a cleaning department, where they are sprayed all over with a naphtha solution. All particles of scale, dirt, or grease are then scraped off by hand, after which the air-brake piping is applied. Then a preliminary coat of paint is sprayed on the car. This operation is performed over a pit, where the men who apply the paint are located; at the same time, the under side of the cars is covered with a non-corrosive heavy paint known as "car cement."

Fig. 1. General View of the Erection Lines in the Huntington Works of the American Car and Foundry Co., where a Coal Hopper Car is Completed Every Eighteen Minutes

When the first coat of paint has dried thoroughly on the cars, a second coat is sprayed on, and later a third coat. Finally, the name of the railroad, the number of the car, the capacity, and other legends are stenciled on the car. The cars are then weighed and turned over to the Chesapeake & Ohio Railroad. It is of interest to note that, although the cars are fabricated from steel sheets and shapes, sheared, punched, and formed by the same machines, so that the dimensions vary but slightly, the cars differ as much as 400 pounds in weight. This is due primarily to variations in the thickness of the materials supplied by the steel mills.

The erection lines are operated nine hours per day, five days a week. Some departments operate twenty-four hours a day, seven days a week, to keep the erection lines busy.

To give an idea of the methods employed in this shop, some typical operations in producing the various components of these coal hopper cars will be described. Fig. 3 shows a Betts-Bridgeford axle turning lathe, which is used to finish the journals and wheel seats of the truck axles after these surfaces have been rough- and semi-finish-turned in two operations performed in machines of the same type. The collar at the outer end of the journals and the large-radius fillet at the other end are also finished by the axle turning lathe shown in the illustration.

Both ends of the axles are turned simultaneously, the lathe being fitted with two carriages, which are provided with three tools each. The axle is driven, in this operation, by a three-jaw chuck at the center of the lathe, the jaws of which are made to grip the axle when a handle at the front of the machine is operated to tighten a cable that extends around the rim of the external chuck member. This causes a braking action that effects a cam movement of the chuck jaws. The carriages are fed hydraulically in opposite directions along the bed. The hydraulic cylinders are mounted on the front of the bed.

About 0.020 inch of stock on the diameter is removed in this operation, and the various diameters are finished to size within 0.002 inch. On the particular axle that is seen in the lathe, the journals are 5 1/2 inches in diameter and the wheel seats 8 1/16 inches in diameter. The axle is 7 feet 4 1/2 inches long over all. At the time that the photograph was taken, the operator was applying a profile gage to determine whether the journal had been turned to the prescribed length.

From this finish-turning operation, the axles are transferred to double-end burnishing lathes, such as illustrated in Fig. 5, in which rolls simultaneously operate against both journals to compress the surface metal. All marks left by the finish-turning tools are completely eliminated,

Fig. 2. The Sub-assembly Station where Center Sills are Riveted to Two Steel Bolsters which have Previously been Positioned in Floor Fixtures

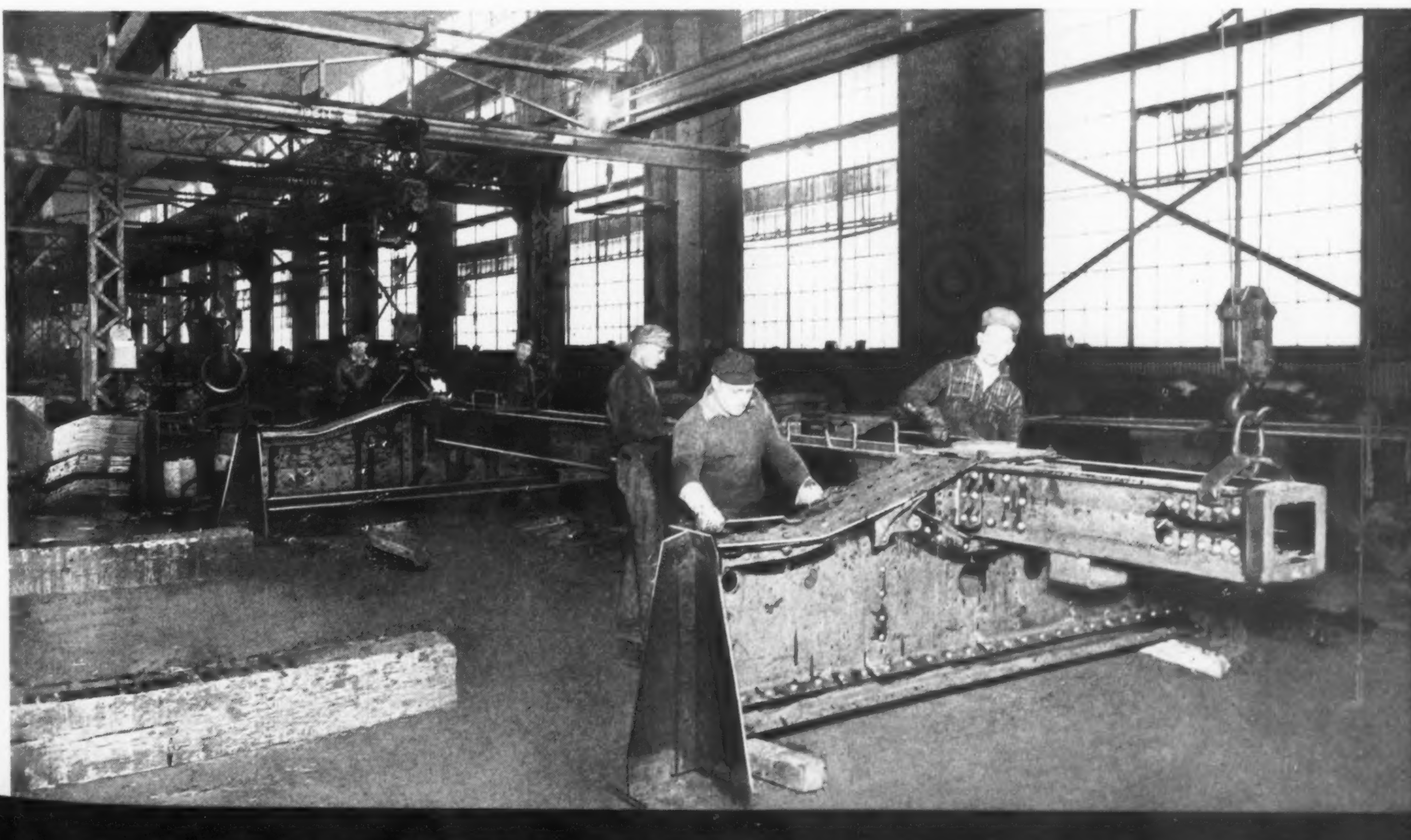


Fig. 3. Center-driven Lathe Employed in Turning the Journals and Wheel Seats of Truck Axles for Coal Hopper Cars

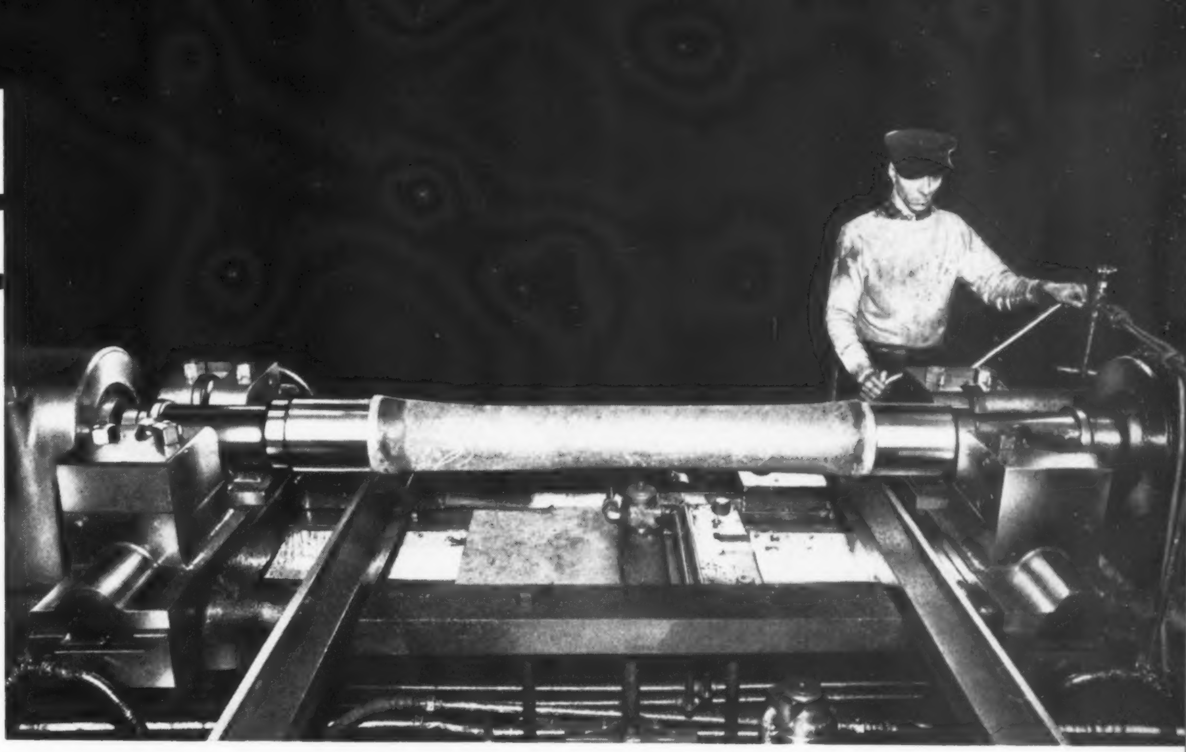
and a smooth, glass-hard surface is obtained. Burnishing rolls are mounted on slides at the front and back of the two carriages. These rolls are 9 3/4 inches in diameter by 1 1/2 inches face width and are fed along the journals by the operation of carriage lead-screws to burnish the journals their full length of 10 1/2 inches. They compress the surface metal of the journals about 0.001 inch.

When an axle is loaded into the machine, the roll carriages are withdrawn a suitable amount for convenient loading. Then both rolls of either pair are moved in unison against the journal by the rotation of a large handwheel at the front of the carriage, the roll blocks being actuated by a single lead-screw having right- and left-hand threads. Each roll is rounded on the inner side to the radius of the journal fillet. One roll of each pair is set 1/64 inch ahead of its mate, so that it alone burnishes the fillet. If both rolls were in contact with the fillet, there would be a binding action. The rolls are made from hardened tool steel.

Each roll runs on a roller bearing, and is equipped with a ball bearing to take end thrust. This is an important requirement because, while the rolls must be firmly supported, they must also run freely. The blocks that hold the roll shafts are split, and can be adjusted sidewise for tightening or loosening the roll assembly. Air hoists located on swinging beams adjacent to the axle turning and burnishing lathes reduce manual labor in loading and unloading these machines.

The chilled-iron car wheels are bored on vertical boring mills, a modern Betts machine of this type being seen in Fig. 4. The wheels for the Chesapeake & Ohio hopper cars are 33 inches in tread diameter. They are rough-bored, finish-bored, and chamfered in one downward feed of a Davis boring-bar, equipped with three cutters as shown. The boring tools extend from both sides of the bar, but the chamfering tool extends from one side only. Stock to a depth of

Fig. 4. Rough- and Finish-boring and Chamfering Car Wheels in One Set-up on a Vertical Boring Mill, Ready for Assembling to the Axles



about 1/4 inch per side is removed in rough-boring, and to 0.020 inch in finish-boring. The ram of this machine is quickly traversed to and from the work by hydraulic power, and fed slowly during the operation, also hydraulically. A swinging beam on a post at the right of the machine facilities loading and unloading of the wheels.

Multiple punching is widely performed on various types of machines to expedite production and insure interchangeability of the various shapes and plates used in car construction. Fig. 6 shows this punching principle being carried out on a large double-housing machine capable of taking plates up to 10 feet wide and of any length required in car building. The operation illustrated consists of punching the rivet holes in a side sheet. Thirteen punches are set up on the ram of the machine, all of which can be used simultaneously, as in punching a row across the ends of the sheets and at intervals along the length. Also, as few punches as desired can be employed, when, for example, holes are required along the sides only, or when one or two holes are to be punched at various points across the sheet.

Above each punch is a small steel block which can be pushed back over the punch shank by means of a handle to provide a backing for the punch when the ram descends, so that a hole will be pierced through the steel sheet. This block is merely pulled forward whenever a

Fig. 5. (Above) Lathe Employed in Rolling the Truck-axle Journals to Give Them a High Polish and a Hard Surface

Fig. 6. (Right) Multiple Punching of Side Sheets on a Double-housing Machine Equipped with a Work-spacing Table

Fig. 7. Operators of Bull Riveters Use Hands and Feet in Positioning the Large Units to be Riveted, and in Actuating the Riveter Ram

★

punch is to be rendered ineffective, in which case the punch will idle in its holder when the ram comes down.

The steel sheet being punched is pulled through the machine as required by the carriage seen in the foreground, to which it is attached by two clamps. This carriage is actuated as the man at the left turns the large handwheel to revolve a shaft provided with pinions that engage racks on both sides of the bed. In a bracket mounted on the left-hand side of this carriage is a latch which automatically engages notches in a templet bar fastened to one side of the rack, as seen in the illustration. This automatically locates the carriage and the sheet being punched for the successive operations. The latch is conveniently raised by moving a handle for feeding to the successive notches of the templet. The men standing adjacent to the machine set the various punch-blocks as required for the successive movements of the ram.

Large car sections, such as the sides, are sub-assembled by bull riveters located over pits in the manner shown in Fig. 7, so that the sections can be readily riveted along their full length and height. The sub-assembly being riveted is suspended from a crane, which is quickly moved longitudinally to carry the work through the riveter as the operator manipulates a handle at his right. The movement of a second handle at his right actuates a hoist on the crane to shift the work vertically. This work-handling equipment is known as a "racking machine." The men at the back of the pit place heated rivets through the various holes in the assembly. As each heated rivet is placed in line with the riveting tools the operator pushes the work against the machine anvil with one foot and operates a handle to his left for actuating the riveting hammer. The pit is 6 feet 5 inches deep and about 2 1/2 feet wide. It extends past several bull riveters.

Mention has been made of the fact that the punched holes in the various structural members are reamed to enable the rivets to be inserted correctly. A typical reaming operation is seen in progress in Fig. 8 along the final erection line at a station where an elevating platform is provided on a gantry structure, built up over the erection line and running on widely spaced rails. By the operation of electrical controls, the platform is instantly raised or lowered to the required heights up to 10 feet, or the entire gantry structure can be moved back and forth to any position within a length of 35 feet. The portable reaming tool is electrically driven, and is suspended from an air hoist, which is also attached to the gantry.

Fig. 8. Elevating Platform on a Gantry which Enables a Rivet-hole Reamer to be Positioned Anywhere along Length and Height of Cars

★

The rivets driven in all operations are heated in Berwick rivet heaters, which insure correct temperature and eliminate the smoke encountered with other types of rivet heating furnaces. One of these electrical heaters is seen in Fig. 9 at a station along the final erection track. This heater is provided with five sets of electrodes. One electrode of each pair is raised by the operation of a foot-treadle to enable the rivets to be put in place and removed.

In addition to building coal cars, the Huntington Works is at present supplying an average of 100 sets of wheels and axles daily to the Chesapeake & Ohio Railroad for maintenance purposes. Mine cars of all-steel construction are also being turned out at 15 to 20 per day.

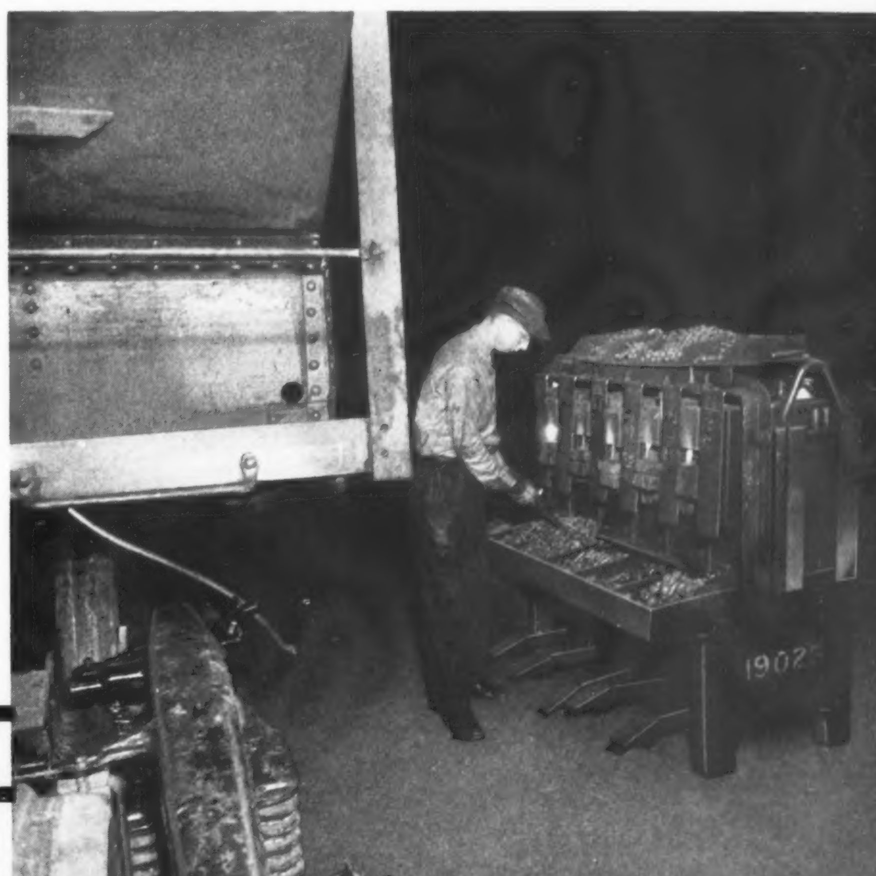


Fig. 9. One of a Large Number of Electric Rivet Heaters that are Located along the Erection Lines and in the Subassembly Stations

★

Producing Westinghouse Equipment

Machining Operations in a Shop Tooled up for the In-Line Production of Motors, Generators, and Other Electrical Equipment for Locomotives of Types Becoming Increasingly Popular with Railway Operating Officials

By R. H. TIMMONS, Superintendent, Transportation and Generator Works
and J. A. DORSNER, Superintendent, Gearing Division, Nuttall Works
Westinghouse Electric and Manufacturing Company

ELECTRIC and Diesel-electric locomotives have achieved spectacular performance records in hauling both passenger and freight trains during recent years and contributed greatly to a general speeding up of railroad transportation. Whereas ten years ago the two principal railway systems that extended from New York to Chicago each operated an extra-fare train that covered the distance between these two cities in eighteen hours, today both of these lines operate seven or eight trains which cover that distance within the time mentioned, and the fastest trains cover the route in sixteen hours. The stretch from Chicago to Los Angeles is run by one train in 39 3/4 hours, as against three or four days a decade ago. Freight trains have also been speeded up.

The Pennsylvania Railroad, more than any other system, has utilized the all-electric locomotive. As a result of the performance records of the electric locomotives first adopted in 1910 for pulling passenger trains into New York City through the Hudson and East River Tunnels, this railroad, in 1933, commenced running electrified trains the entire distance between New York City and Philadelphia. In 1935, this service was extended to Washington, and later to Harrisburg, Pa. Today more than 250 electric locomotives are operated over these Pennsylvania tracks.

Diesel-electric locomotives have attained even greater prominence in the popular mind as the result of their high-speed performance in practically all sections of the country over both long

t

for Electric and Diesel Locomotives

and comparatively short runs. In addition to their use as the motive power of fast streamline trains, locomotives of this classification in smaller horsepower ratings have been employed by many roads for a longer period as switching locomotives on the freight-crowded tracks of our large cities.

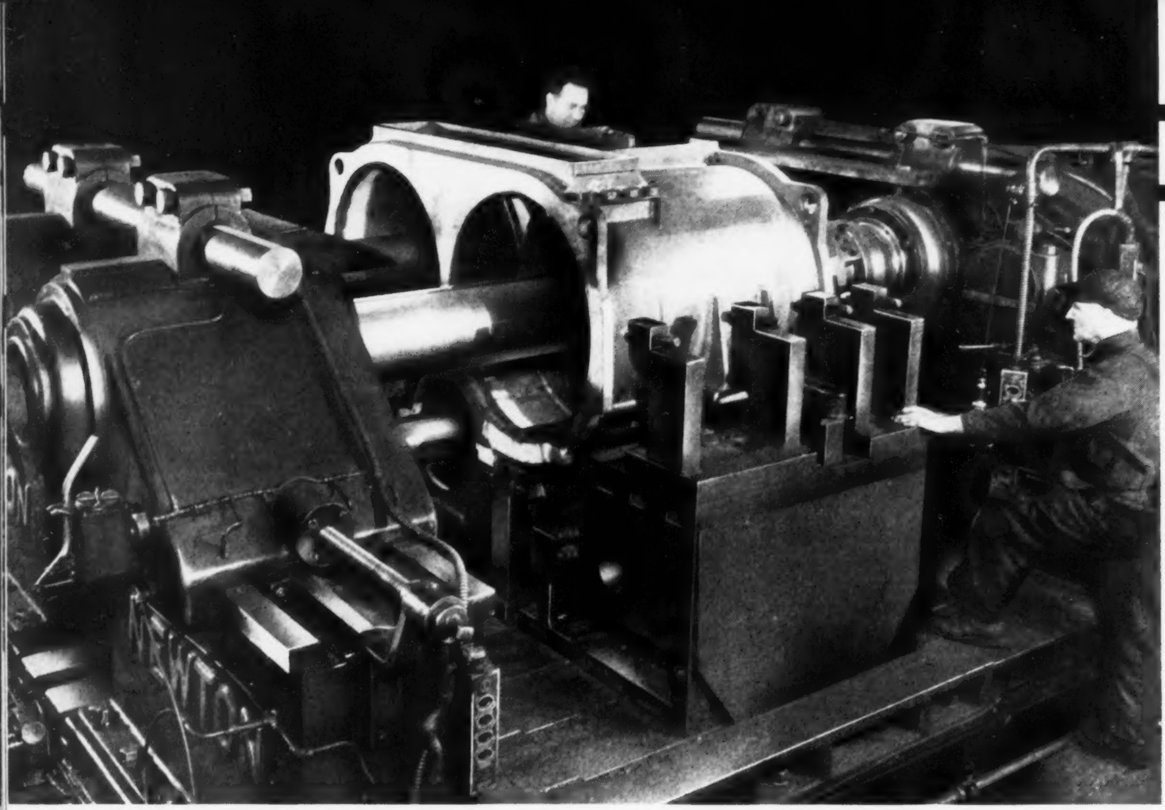
Electric and Diesel-electric locomotives are not new with the Westinghouse Electric & Mfg. Co. Back in 1893, Westinghouse and the Baldwin Locomotive Works pooled their railroad experience and developed the first Baldwin-Westinghouse electric locomotives. The two concerns have been operating on this basis ever since, the Westinghouse company supplying the electric motors and other electrical equipment, and the Baldwin Locomotive Works the remainder of the locomotives. Diesel-electric locomotives have been built by Westinghouse since 1925, when the concern supplied two locomotives of this type to the Canadian National Railroad, and marked a new era in railway transportation.

Today, Westinghouse has a large backlog of orders for electrical equipment to be applied to locomotives of the types mentioned. Motors for these locomotives are machined, wound, and tested in a building of the East Pittsburgh plant that was laid out and tooled up as much as possible for quantity production. There is a straight-line advance of the motors from the raw material storage departments at one end of the building to the testing and shipping departments at the opposite end. Motor frames are fabricated from steel plates, bars, and shapes by electric arc-welding, and then annealed. Next they are transported to the necessary departments for the machining operations, then to departments where the rotors and stators are built up and wound, and finally to the testing stands. Typical operations in this shop will be described in the following.

In the fabrication of motor and generator frames, the various pieces are clamped in jigs to insure interchangeability, and are tack-welded together while in the jigs. The frames are then placed on a welding positioner, as shown in Fig. 1, by means of which the work can be revolved or tilted into any desired position, so that the bead of electrode laid in arc-welding can always be deposited in a horizontal plane. The table of the positioner can be revolved about a complete circle, and this can be done in an actual operation for laying a bead around circular joints. The table can also be tilted through 160 degrees on a horizontal axis. The motor frame seen on this positioner is for a Diesel-electric 100- or 125-ton locomotive.

One of the largest machine tools in the locomotive shop is the triple-bar horizontal boring machine shown in Fig. 2, which weighs about 160,000 pounds. This machine is equipped with two boring-bars 10 1/2 inches in diameter and a third boring-bar 6 inches in diameter. The machine is used for rough- and finish-boring both cylinders of fabricated twin-motor frames to receive the stator laminations, for rough-boring the housing fits at each end of both motor openings, and for rough- and finish-boring bear-

Fig. 1. Using a Cullen-Friestedt Welding Positioner in Arc-welding a Motor Frame for a Diesel-electric Locomotive



ings along the center in the bottom of the fabricated frame to receive the axle quill.

A close-up view of the three boring heads is seen in Fig. 3. As many as thirty-two tools can be mounted on these heads, and up to twenty-four of them can be applied simultaneously. The motor frame is held on a stationary table, and the operation performed as the headstock of the machine feeds the boring-bars horizontally through the work. The outer ends of the bars are supported in pilot bushings in the tailstocks seen at the left in Fig. 2. These tailstocks can be adjusted transversely by screws to obtain the center-to-center distances corresponding with the various sizes of motor frames handled.

Interchangeable motor frames are produced with this equipment, as the construction of the machine insures close parallelism of the boring-bars and accurate center distances between the stator bores and the axle-quill bearings. In the operation illustrated, the stator bores were machined to 29.8125 inches within plus 0.002 inch, minus nothing, and the quill bore to 16.500 inches within plus 0.004 inch, minus nothing. Two tools are used in each head for the various roughing cuts and one tool for finishing. The housing fits at the opposite ends of both motor openings are later finished concentric with the stator laminations in the same operation as that in which the laminations are bored. Six of these twin-motor frames are regularly required for each Pennsylvania electric locomotive. Each motor develops 385 horsepower, making a total of 4620 horsepower per engine.

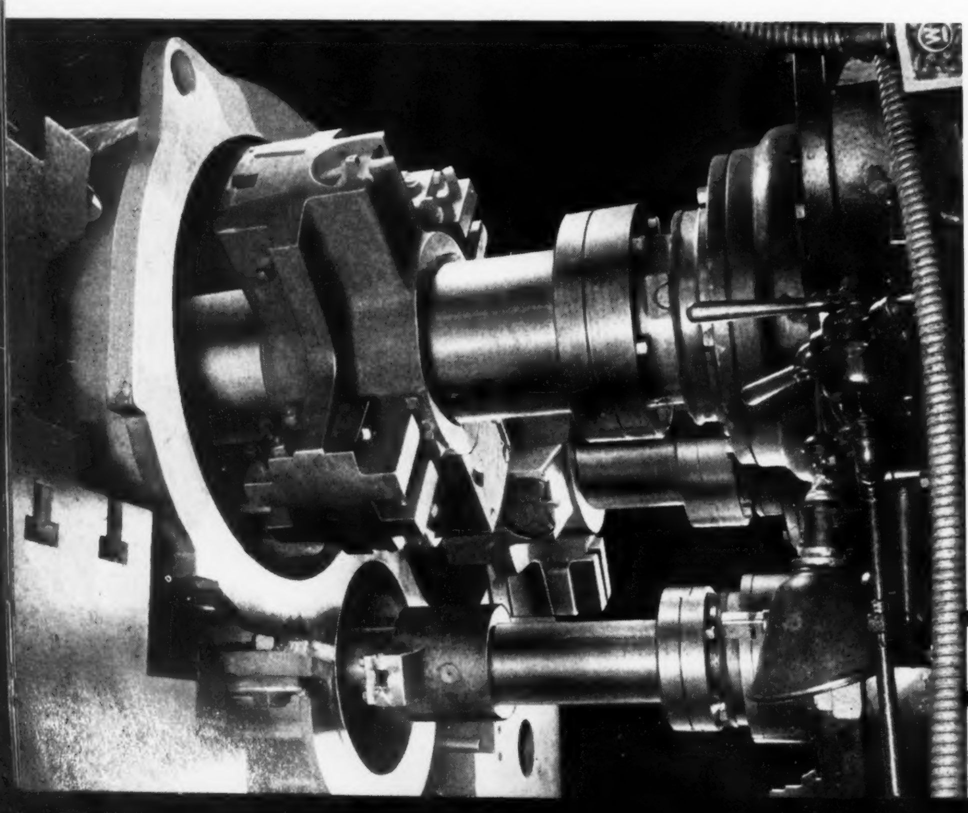
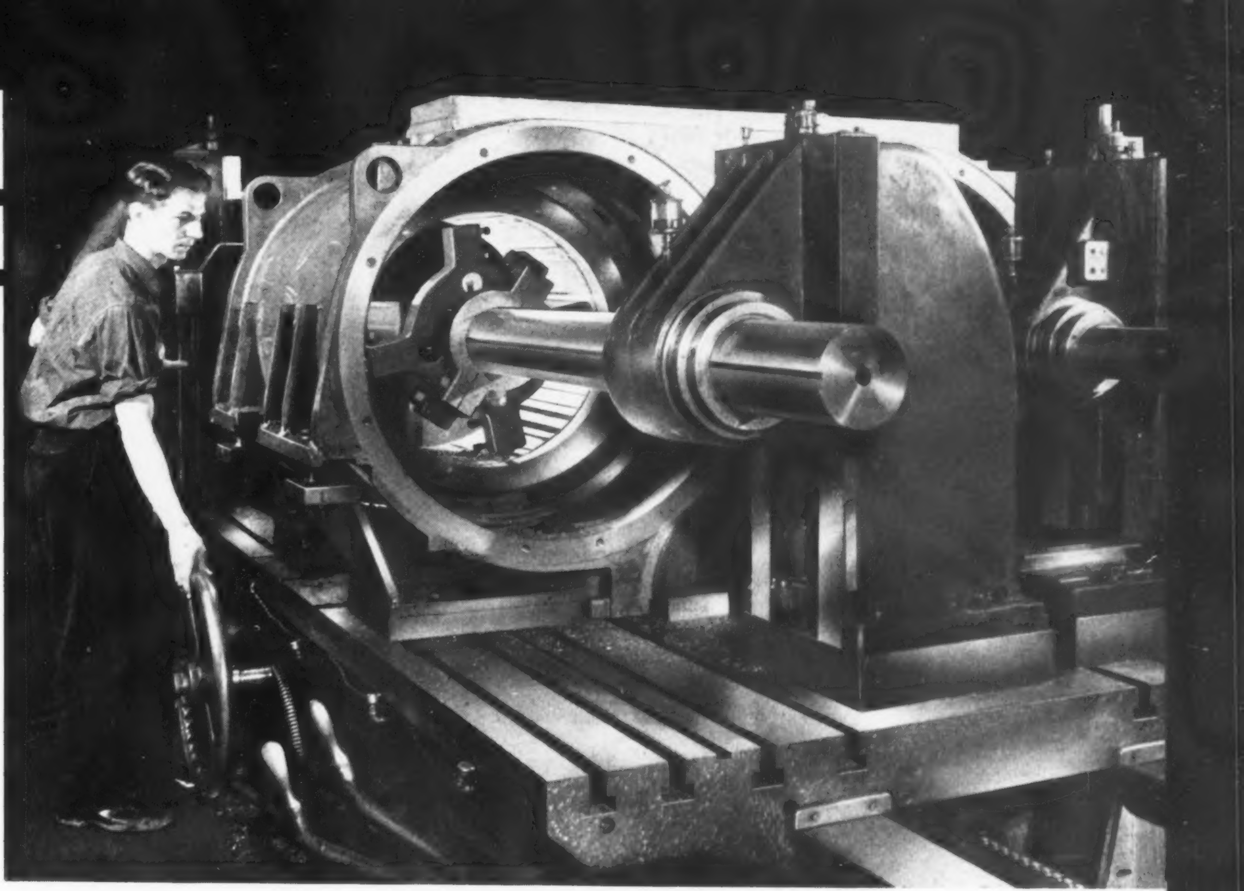


Fig. 2. (Above) Betts Triple-bar Boring Machine which Simultaneously Machines Both Stator Cylinders of Twin Motor Frames and Also the Quill Bearings

Fig. 3. (Left) Close-up View Showing the Three Boring Heads of the Triple-bar Boring Machine Illustrated in Fig. 2



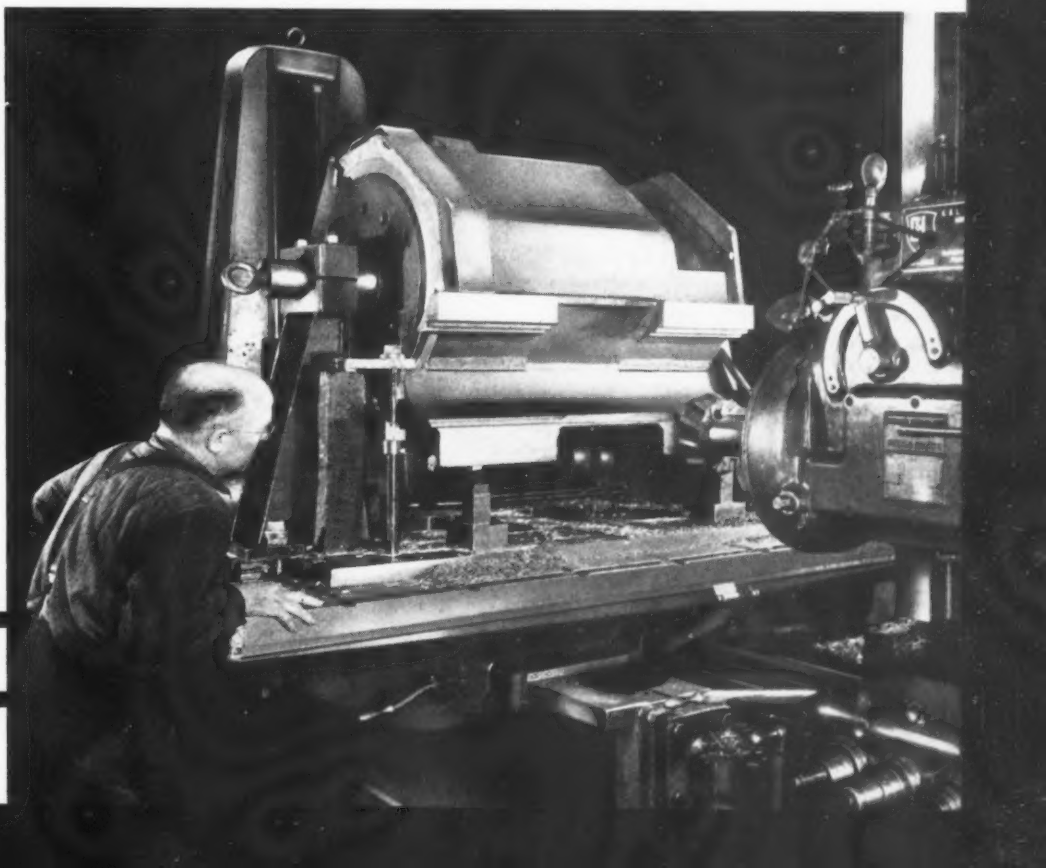
The boring of the laminations after they have been assembled in these frames and the finish-boring of the housing fits are performed with the two-spindle boring mill illustrated in Fig. 4. Prior to this operation, the bearing cap for the quill is removed and the machined quill bearing surfaces in the frame are seated over half-round mandrels mounted in the center of the table that are of the same diameter as the quill bearings. With this set-up, the laminations and housing fits are machined accurately with respect to the center of the quill bearings.

The boring-bars of this machine are held in adjustable supports on both ends of the work, so as to insure close parallelism, as well as accurate center-to-center distances. Boring is accomplished by feeding the work-table along the revolving tool-bars. Sintered-carbide cutting tools are used in roughing and finishing. The laminations are bored to 23.200 inches plus 0.002 inch, minus nothing, while the two housing fits are finished to 31.500 and 30.000 inches, both within plus nothing, minus 0.002 inch.

Milling is performed on these motor frames for a Diesel-electric switching locomotive by the horizontal boring, drilling, and milling machine shown in Fig. 5. In this case the motor frame is mounted on a fixture that can be indexed on a horizontal axis to present the various surfaces to be milled toward the cutter. At the left-hand end of the fixture is a templet with which the faces of the milling cutters are brought in contact for quickly setting them as required for some of the cuts.

Fig. 4. (Above) Boring the Stator Laminations in a Twin-motor Frame on a W. F. & John Barnes Two-spindle Boring Mill

Fig. 5. (Right) Applying a Giddings & Lewis Horizontal Boring Mill for Face-milling External Surfaces around a Motor Frame for a Diesel-electric Locomotive



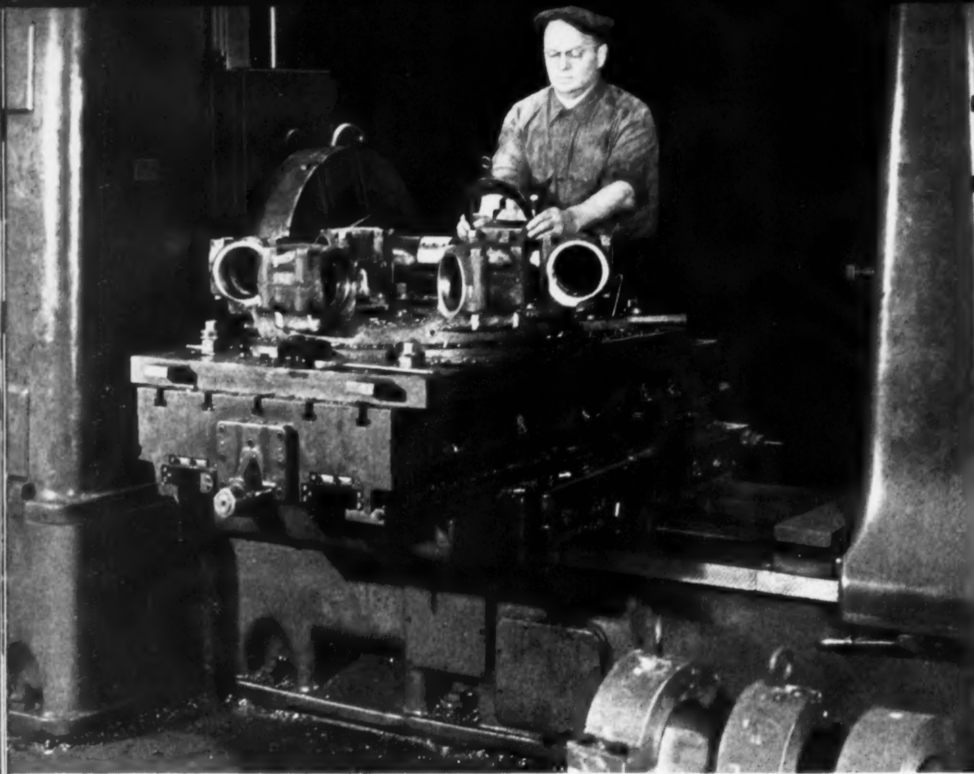


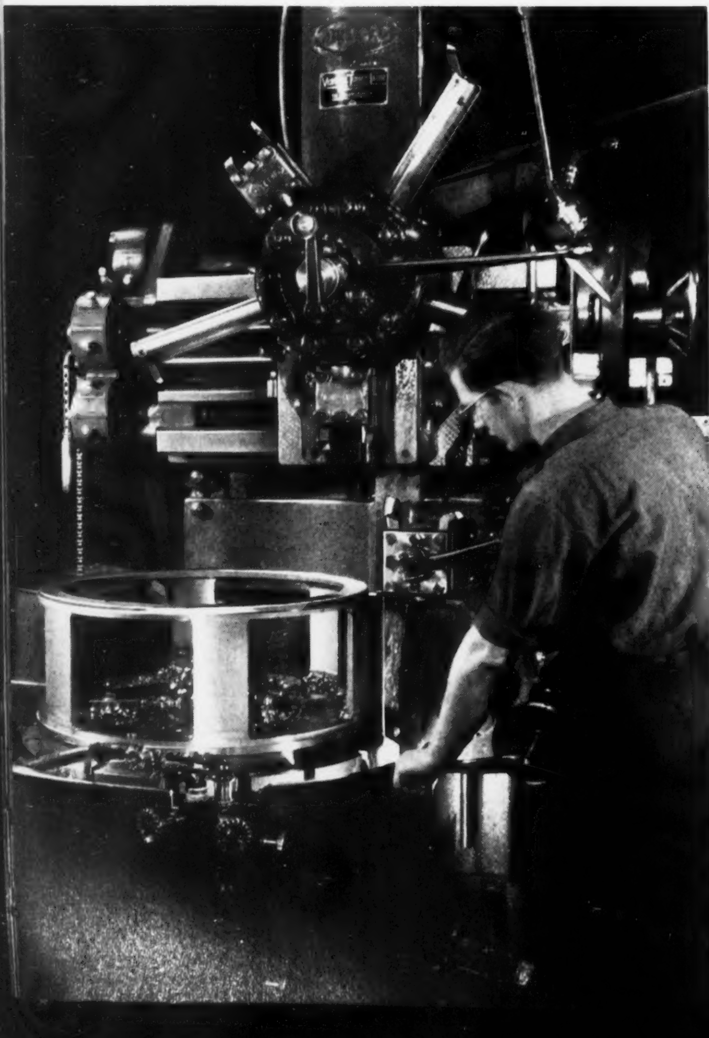
Fig. 6. (Left) Another Giddings & Lewis Horizontal Boring Mill Face-milling, Boring, and Grooving the Six Pockets of the Quill Drive

Fig. 7. (Below Left) Turning, Boring, and Facing a Rocker Ring on a Bullard Vertical Turret Lathe

Fig. 8. (Below Right) Drilling, Countersinking, and Tapping Rocker Rings on an American Radial Drill

Another horizontal boring, drilling, and milling machine is shown in Fig. 6 set up for boring, facing, and grooving the spring cup seats in large spiders used on Pennsylvania electric locomotives for transmitting the power from the traction motor quills to the locomotive wheels. The spider is mounted on an indexing fixture, so that each of the six bearings can be successively indexed into line with the machine spindle for boring and facing. Then a special boring head with two single-point cutters is mounted on the machine spindle, and the bearings are again brought individually into line with the spindle for cutting two grooves in each bearing. The tools can be adjusted radially outward after they have been positioned within each bearing as required.

A rocker ring for an electric locomotive motor is seen in Fig. 7 being turned, bored, and faced on a vertical turret lathe. In addition, an under-cut is taken on the flange, and also a chamfering cut. Seven cutting tools on the turret



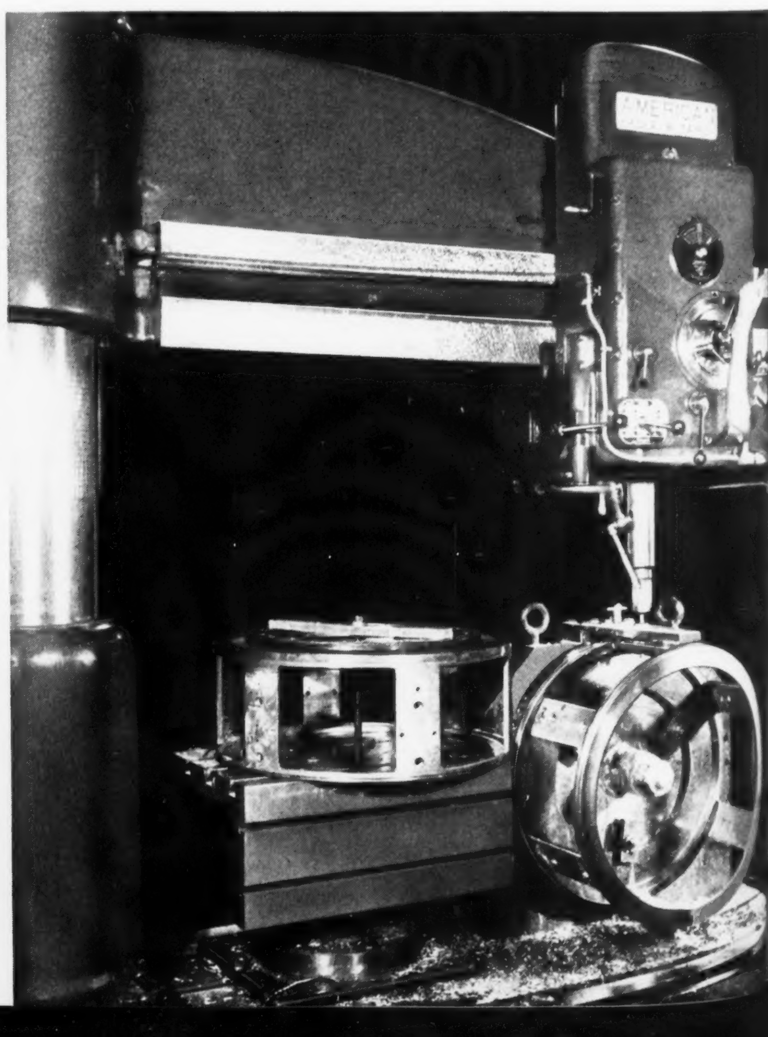
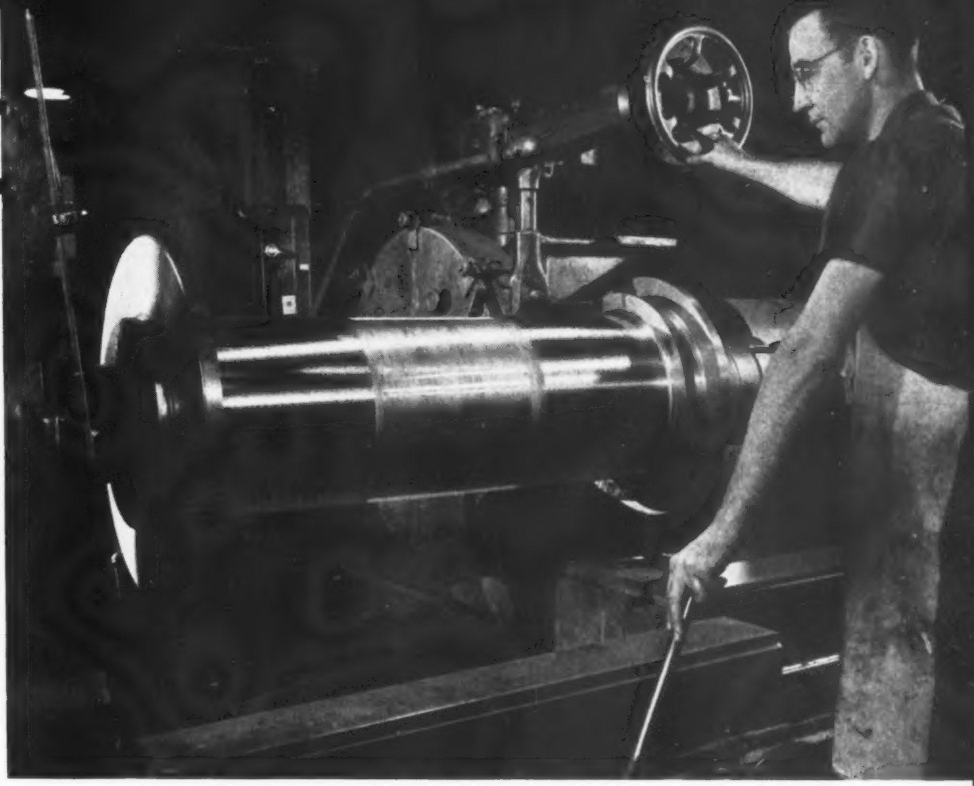


Fig. 9. Landis Cylindrical Grinding Machine being Used for Finish-grinding Two Surfaces on the Quill for an Electric Locomotive to Receive Roller Bearings



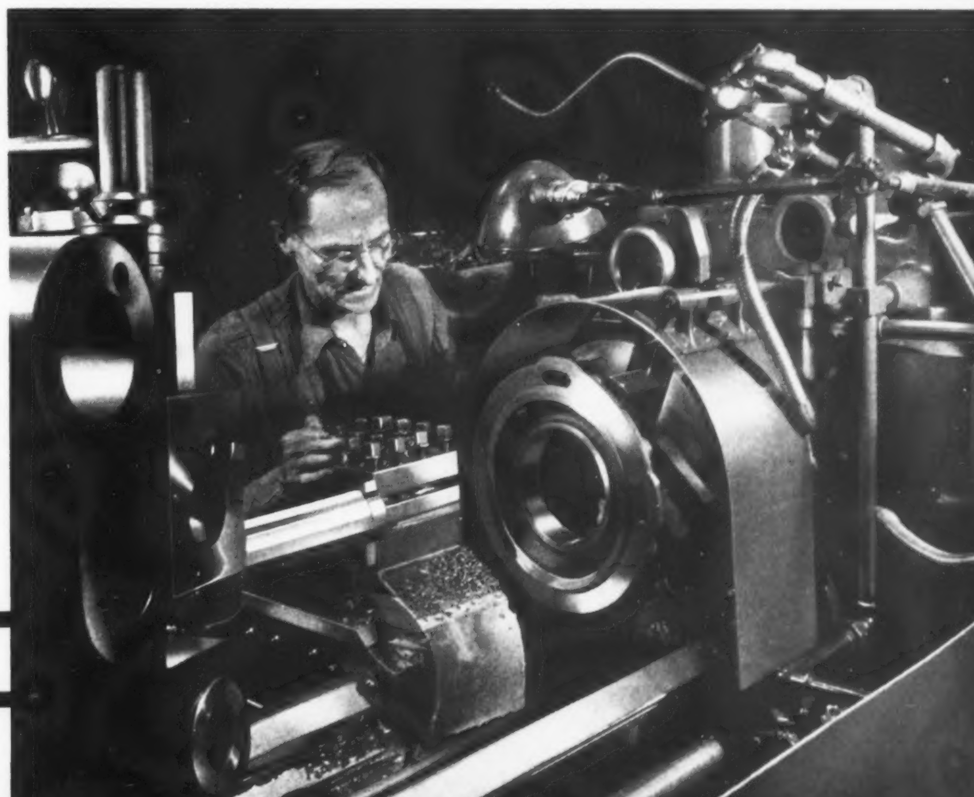
and three on the side-head are used. The outside diameter of the part must be 31.436 inches plus nothing, minus 0.002 inch, and similar tolerances are specified for other diameters. The tolerance on the height is 0.005 inch.

From this vertical turret lathe the rocker rings go to the radial drilling machine shown in Fig. 8. Here they are first mounted on the indexing jig seen at the right-hand end of the table for drilling and countersinking two holes in each of the six ribs, which are later used in welding the alignment keys which locate brush-holder supports to the rocker ring. Also, while in this jig, three bolt-holes are drilled and tapped in each rib. Slip bushings for guiding the drills are held in a bracket that extends across the top of the work. The jig is quickly locked in the required settings by the use of a dowel-pin which engages holes in the movable jig member. Several combinations of dowel holes are provided for accommodating rings of different sizes.

When this operation is completed, the rocker ring is clamped on the tilting table seen at the left for drilling twelve holes, 7/16 inch in diameter, around one flange in accordance with a jig bushing ring fastened on top of the part. These holes are used in bolting a gear to the rocker ring.

An axle quill for an electric locomotive is shown in Fig. 9 being finish-ground on a cylindrical grinding machine of considerable size. Two diameters for roller bearings are ground on the quill to the specified dimension within plus or minus 0.001 inch.

Fig. 10. Machining Malleable-iron Motor Castings on a Warner & Swasey Turret Lathe Equipped with Sintered-carbide Tools



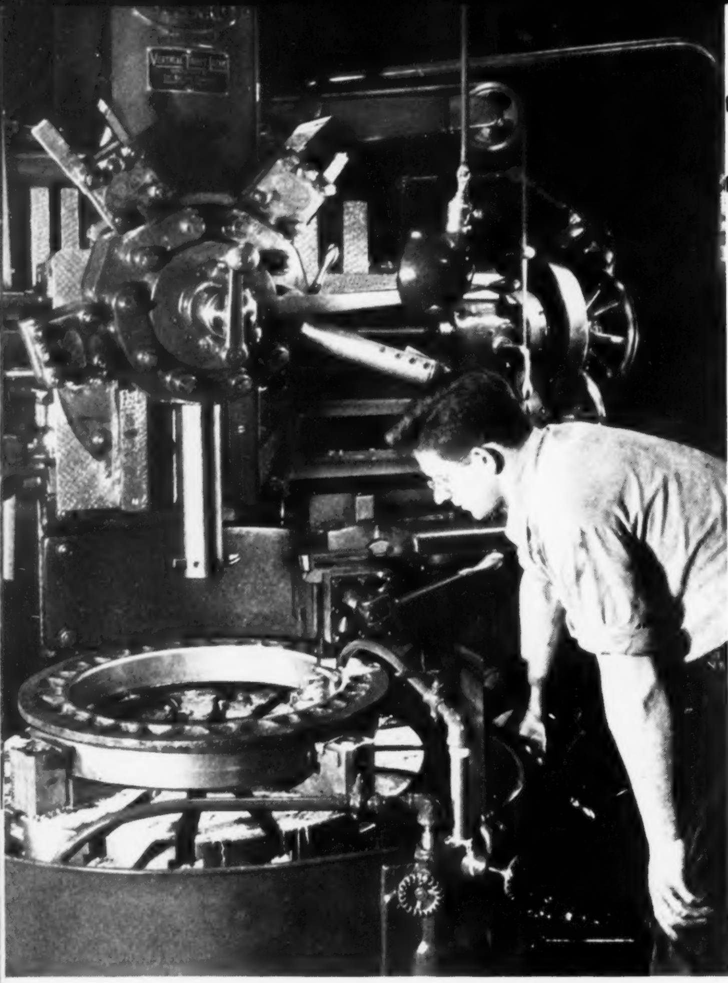
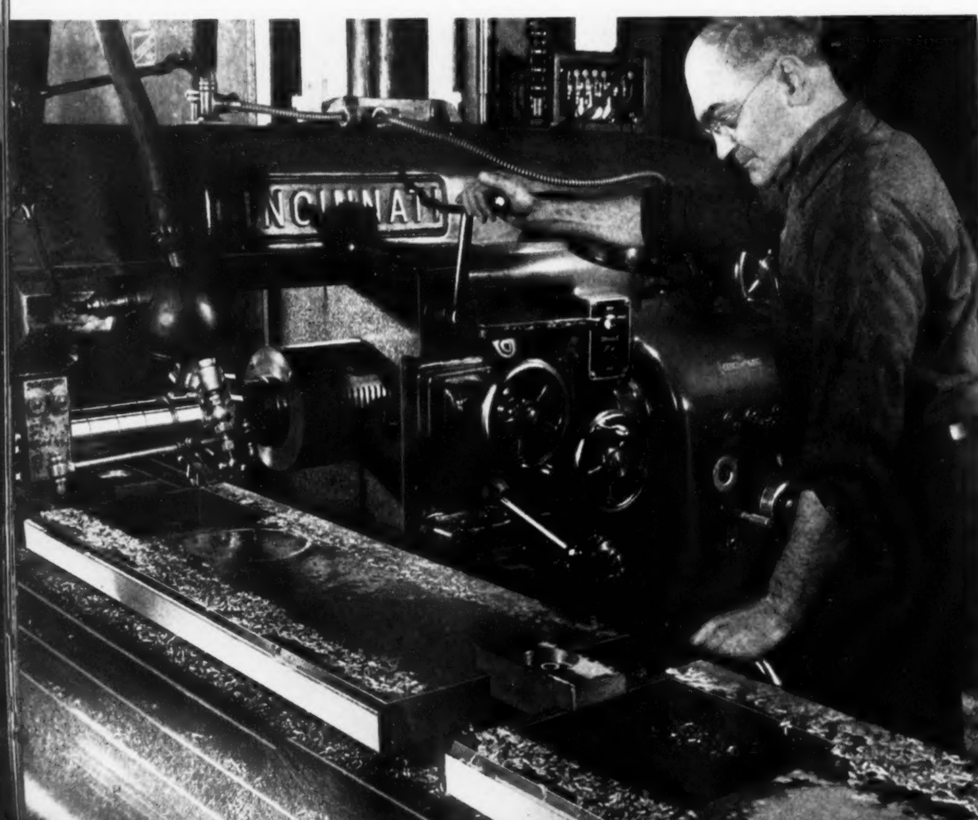


Fig. 11. Bullard Vertical Turret Lathe Shown Engaged in Boring, Turning, and Facing a Front End Plate for a Generator

★

Fig. 12. Machining Steel Plates on the Sides to Prepare Them for Fabrication by Welding into Motor Frames



A close-up view of a turret lathe being used for machining malleable-iron pinion end-bearing caps for electric locomotive motors is shown in Fig. 10. Sintered-carbide tools are employed on this machine for all cuts. Two tools mounted on one side of the cross-slide tool-block are used simultaneously for finishing two faces and a shoulder, after these surfaces have been roughed out with a single tool on another side of the tool-block. Tools on the turret are used to take roughing and finishing cuts in the bore. The tolerance on the turned shoulder is only 0.001 inch, while the bore has a considerably larger tolerance.

The application of a Cincinnati Hydrotel milling machine for machining heavy steel plates prior to fabrication into motor frames by electric welding is shown in Fig. 12. The edges of the plates are machined with a step on top to receive electrode deposited in the welding operation. Four cutters are mounted on the machine spindle, two on each side of the plates being milled. In each pair there is a small-diameter cutter with blades ground at an angle for milling the step, and a larger diameter face mill for machining the full edge of the plates.

Vertical turret lathes are used for a considerable number of operations in addition to the one already described. In Fig. 11, for example, a machine of this type is being used for an important operation on the front end plate of a generator armature intended for application on a Diesel-electric switching locomotive. The finished bore must be 21.031 to 21.033 inches in diameter. Both sides of the steel casting are

★

faced on this machine, and it is completely turned, as well as bored. One end is turned to a taper of 3 degrees 30 minutes closely concentric with the bore. Five tools are used on the turret and one on the side-head. In facing, the cut is constantly interrupted because of the large number of cored holes.

Gears for electric and Diesel-electric locomotives are produced in the Nuttall plant in sizes ranging from 7 to 60 inches in pitch diameter and from 4 1/4 to 6 inches in face width. The teeth range from 3 to 1 3/4 diametral pitch. On large electric locomotives of the Pennsylvania Railroad type there are six gears and twelve pinions for the quill drives. All locomotive gears are made with spur teeth as necessitated by the allowance of a limited amount of armature float and side sway of wheels and axles.

The gears for these large electric locomotives are cut from rolled-steel rings, which are first turned, faced, and bored on vertical turret lathes. Later the teeth are cut by the hobbing process and the gears are then heat-treated. After heat-treatment, the gear teeth are corrected for distortion in the grinding machine shown in Fig. 14.

In the gear-tooth grinding operation, the gears are held in a fixed position while a grinding wheel dressed to a profile corresponding to the sides of two adjacent teeth is passed back and forth across the gear from one side to the other. The gear blank is then indexed to the next tooth space and the operation repeated. A close-up view of the wheel and a gear being ground for an electric locomotive is shown in Fig. 13.

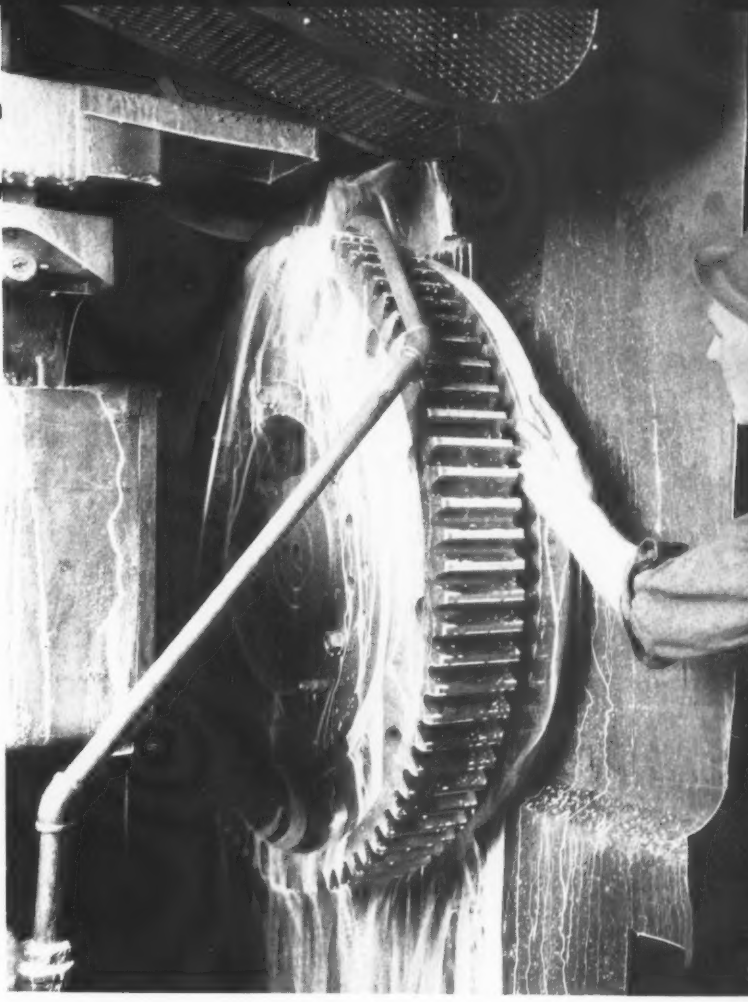
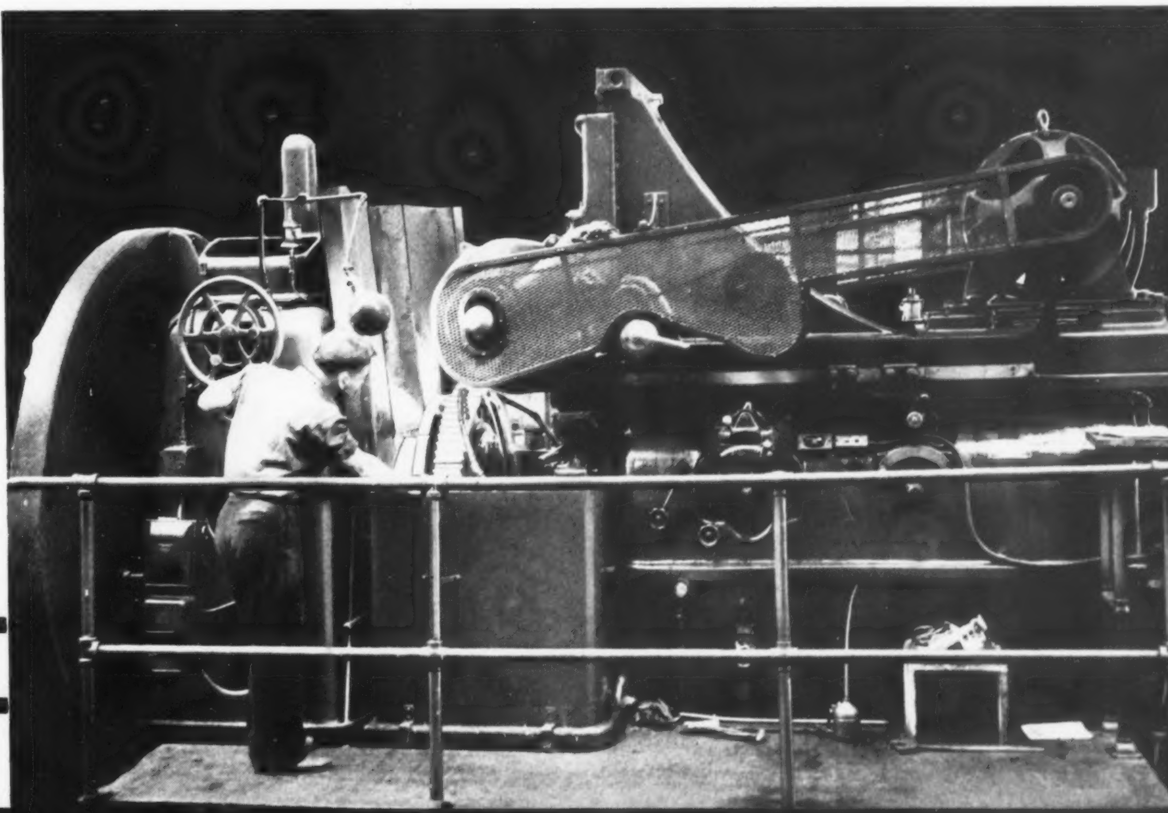


Fig. 13. Close-up View of a Typical Operation Performed on the Large Gear-tooth Grinding Machine Shown in Fig. 14

★

Fig. 14. Gear-tooth Grinding Machine Built by Gear Grinding Machine Co. Finishing Teeth of Locomotive Gears



★

Keeping the New York Central's

By CHARLES O. HERB

THE job of keeping in repair the locomotives and other rolling stock of a vast railway system is one of huge proportions, even in time of peace. With the nation at war, this job is greatly magnified, as the railroads are called upon to carry increased loads of ore and coal to mills for producing munitions, to transport partially manufactured work between factories, and finally, to take the finished tanks, guns, shells, etc., to Army and Navy establishments. At the same time, the railroads must convey increased quantities of food and other necessities of life for both the armed forces and civilians from one end of the continent to the other. Passenger traffic also is multiplied in carrying soldiers to and from camps, and by the increased business activity.

The New York Central Railway System has almost four thousand locomotives in active use at the present time, including steam, electric, and Diesel electric types. These engines, as well as a hundred thousand or more passenger, freight, and coal cars, are kept in repair by seven maintenance shops situated in various convenient localities. The "Central" shops are noted among railway men for the modern methods employed and their high efficiency. Typical operations in the Collinwood (Cleveland) and Beech Grove (Indianapolis) shops of this railroad system, are described in this article.

It should be emphasized, to begin with, that the methods used today in railroad shops are vastly improved over the methods employed twenty or thirty years ago. Many locomotive parts are now machined to micrometric dimensions; such parts as main- and side-rods, main axles, crankpins, pistons, cross-heads, and car axles are carefully "Magnafluxed" to detect any flaws otherwise not apparent; heat-treating operations are accurately controlled with modern equipment; the hardness of parts must meet rigid requirements as checked with testing machines; and so on.

The large tires for locomotive driving wheels are bored to an exceptional finish on the Betts vertical boring machine illustrated in Fig. 1, which is seen performing the operation on a 72-inch diameter tire. Vascoloy tools are used. With the tire revolving at a speed of 200 surface feet a minute and employing a fine finishing feed, a highly polished bore is obtained, which is completely free of any tool marks that might start progressive fractures when the tire is placed in service. The tool on the left-hand head rounds the inner corner of the tire.

4000 Locomotives in Running Order

After the operator has taken a light cut on the bore, he determines the diameter with an inside micrometer, after which he uses the micrometer dials on the feed-screws of the tool-heads in feeding the tool-heads sidewise to obtain the right work diameter. Special clamps have been provided on the table which have swinging arms that can be tightened on top of the tire after they have been fed into gripping contact with the tire tread.

When the tires have been bored, they are heated and shrunk on wheel centers that have previously been mounted on axles. They are then turned in a conventional wheel-turning lathe. Fig. 3 shows a Sellers 90-inch machine of this type. Both wheels on an axle are turned simultaneously through the use of two tool-slides at the front of the machine. Fig. 2 shows a close-up view of one of these tool-slides, each of which is equipped with three cutters.

The roughing cutter for the tread, which is seen on the left-hand side of the indexing tool-block, is a round bar of Crucible Rex 95 high-speed steel. It is 1 1/2 inches in diameter by 2 1/4 inches long, and is ground concave on the cutting edge. Roughing cuts are commonly taken at depths of 1/4 to 3/8 inch on these tires, which are rolled from steel containing 0.61 to 0.80 per cent carbon. As the cutting edge of this tool wears, the tool is turned slightly in its holder to present another sharp edge. This procedure is repeated until the tool has become dull around its entire periphery, after which it is reground. The tool is a tight fit in its holder, just tight enough so that it can be readily knocked out for making new settings and regrinding. In using this tool, it is fed across the tread, as in ordinary turning.

The tire flange is next rough-formed by means of the form cutter seen in the foreground of Fig. 2, which is fed straight into the work. Then the form cutter that is seen in use is employed to finish both the flange and the tread, giving the tire its correct contour. This tool is also fed straight into the tire. The diameter of the finished tires must be true within 0.001 to 0.008 inch, the tolerance depending upon the type of wheel being machined.

In the wheel-turning operation, the axle is supported on centers. When solid-center wheels are being turned, the driving dogs used have teeth so designed that the heavier the cut, the deeper the teeth will dig in. With spoke-center wheels, yoke type clamps are used, which can be tightened on bolts that project between the spokes, or dogs that come in contact with the sides of the tire, similar to those that are employed on solid-wheel centers.

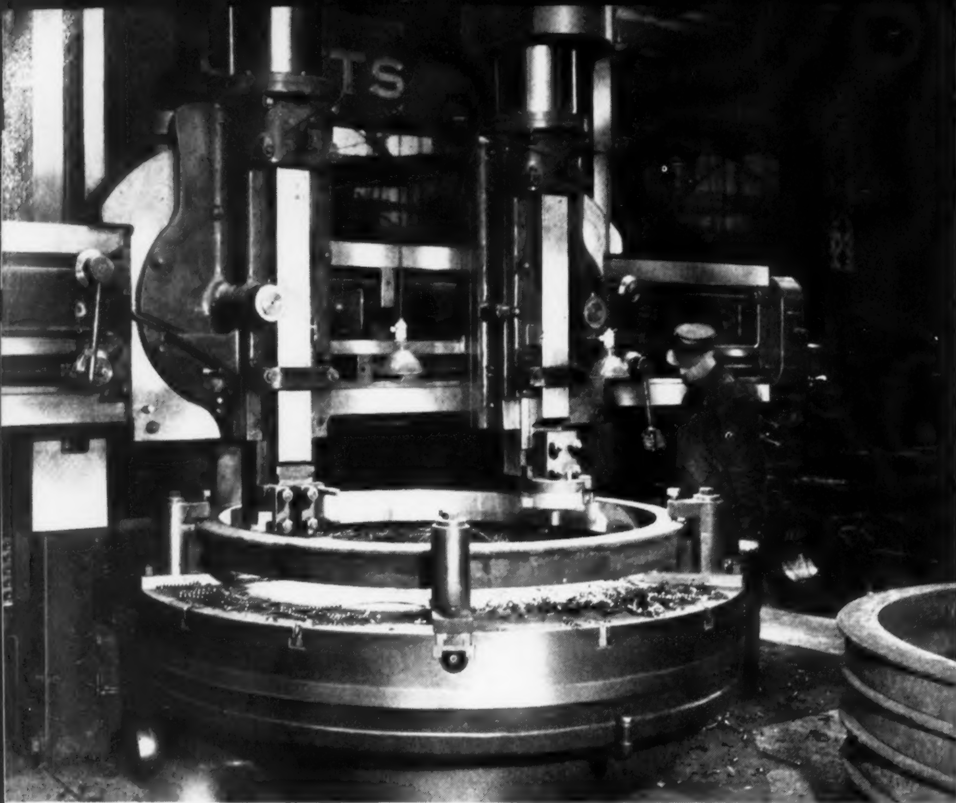


Fig. 1. Boring Locomotive Tires to an Exceptional Finish on a Vertical Boring Mill of Modern Design, Using Carbide Cutters

★

The flange-roughing and contour-finishing tools are accurately ground to their required forms by applying the Gorham vertical-spindle grinding machine shown in Fig. 4. A wheel is employed that has been ground to the desired clearance angle of the cutters. The work is clamped on a ball-bearing table, which can be readily moved to and from the grinding wheel, and also sidewise with respect to the wheel. A templet of the same outline as that to which the cutter is to be ground is mounted on the table in back of the work.

In an operation, the front edge of this templet is held by the operator against a small roller on a post that extends upward through a slot in the table from a slide underneath. The position of this roller controls the distance between the grinding wheel and the front edge of the templet, and thus governs the amount of stock that is ground off the tool as the work-table is moved from right to left and in and out.

There is a micrometer adjustment for the roller post, so that the distance between the roller and the grinding wheel can be changed to vary the depth of stock removed. Also, the wheel-spindle can be raised and lowered to suit as its diameter is reduced by dressing. The correct height of the wheel is determined by means of a gage after each dressing. The dressing tool is conveniently mounted on a bracket in back of the wheel. In the illustration, the dresser-slide, with a diamond in place, is seen lying in back of its holder. The holding bracket can also be adjusted in and out to suit the wheel diameter. In dressing the wheel, the wheel-spindle is moved up and down past the diamond.

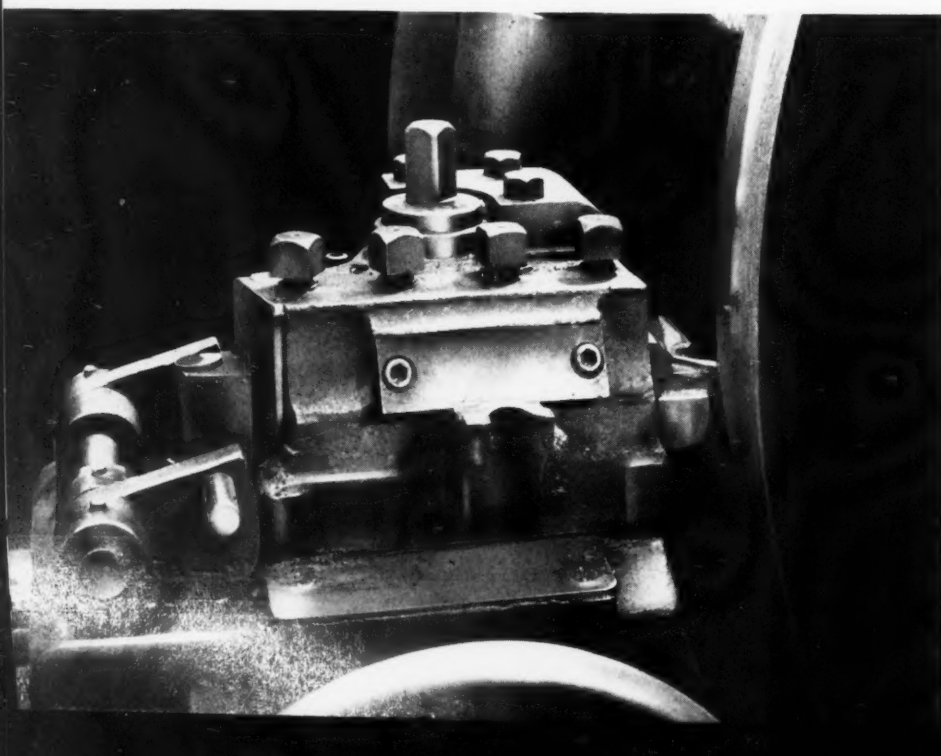


Fig. 2. One of the Tool-blocks on the Wheel-turning Lathe Illustrated in Fig. 3. Equipped with Three Cutters

★

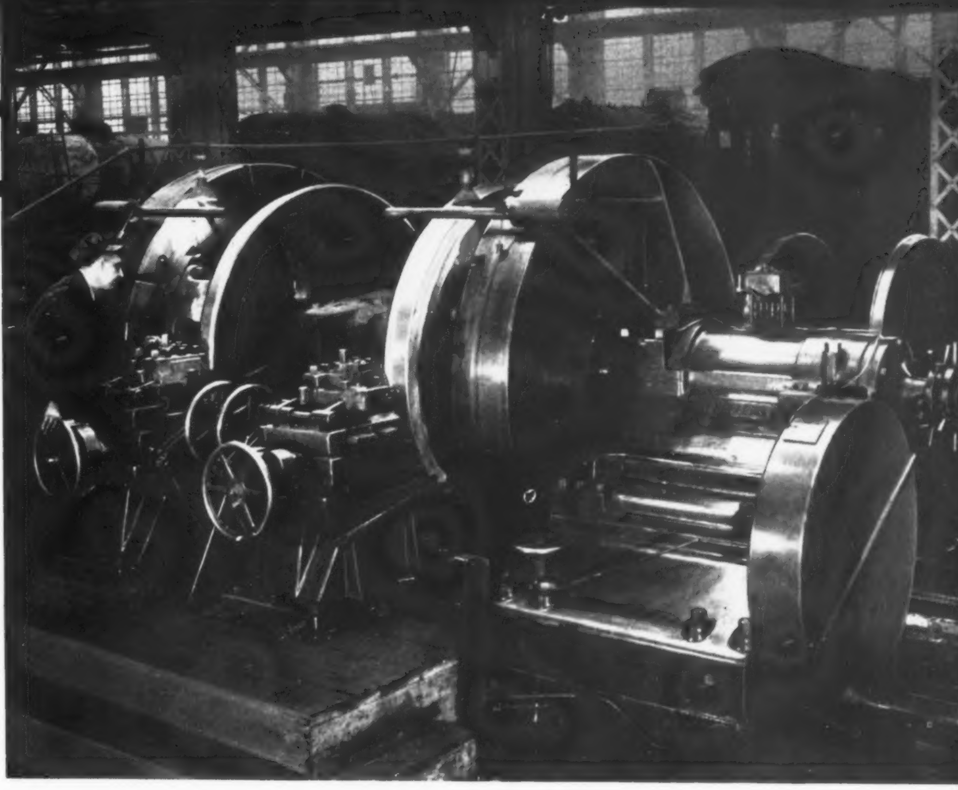


Fig. 3. Wheel-turning Lathe in which the Tread and Flange of Wheels as Large as 90 Inches in Diameter are Rough- and Finish-turned

★

The particular operation illustrated consists of sharpening a tire contour tool. The wheel is ordinarily dressed to an angle of 4 1/2 degrees to give the desired clearance to the cutting edge. Cutters of opposite contours for right- and left-hand treads can be ground from one templet by reversing the position of the templet on its table.

The large axle seen in Feb. 5, which has been machined to receive Timken tapered roller bearings, is being burnished in the center section between the bearing surfaces. This operation is performed to compress the surface metal, so as to eliminate any tool marks which might open up in service. The burnishing roller is attached to a shank which is clamped in the regular tool-post of the lathe. This roller is 4 inches in diameter by 1 3/4 inches face width. The face is slightly rounded and the roller is made of high-speed steel and ground and polished to a fine finish.

This 69-inch long axle comes to the Lodge & Shipley lathe in which the operation is performed as a semi-finished forging. While in this lathe, the seats for the roller bearings are finish-turned to a diameter of 14 inches within plus or minus 0.0005 inch. For the finishing cuts, tools made of Rex AA high-speed steel are used.

Bearings for main side-rods are turned, faced, and bored at a high rate of speed by the Bullard vertical turret lathe shown in Fig. 6. These parts are cast from a standard bearing metal. The particular examples shown are 11 1/8 inches outside diameter by 7 7/8 inches inside diameter and 14 inches long. They are rough- and

Fig. 4. Contour Grinding Machine Employed for Sharpening the Flange-roughing and Flange and Tread Contour Cutters

★

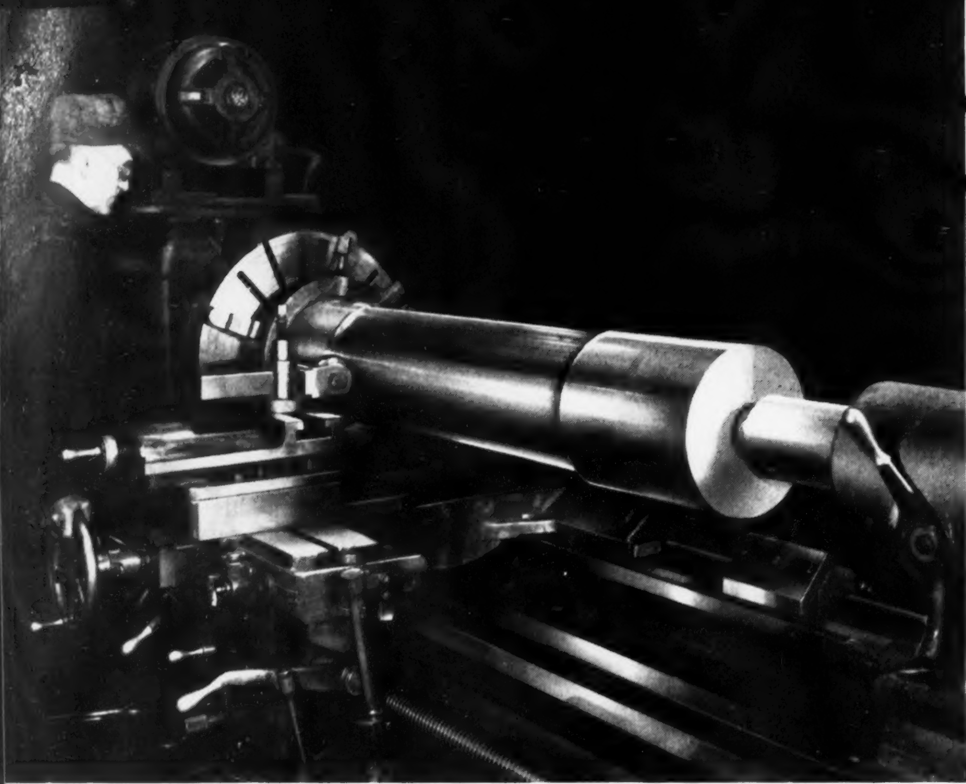


Fig. 5. (Left) Burnishing a Locomotive Axle to Remove Tool Marks and Eliminate Danger of Fractures

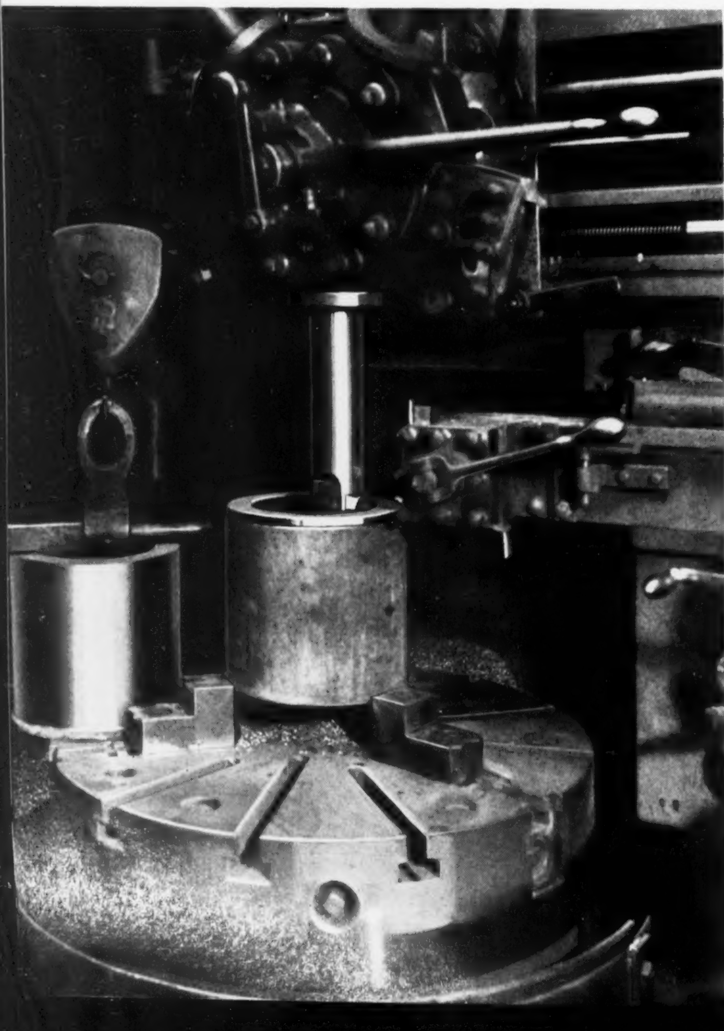
Fig. 6. (Below Left) High-speed Turning, Boring, and Facing Operation on Side-rod Bearings

Fig. 7. (Below Right) Cross-heads are Bored, Turned, and Faced on a Vertical Turret Lathe

finish-machined in a floor-to-floor time of eight minutes. A roughing cut is taken at a depth of 1/4 inch. The work is run at 125 R.P.M., and the tool feed is 0.083 inch per revolution. Vascoloy tools are used in this operation.

In starting the roughing cut, the correct position of the tool is determined by means of a micrometer gage. Inch graduations on the cross-rail are used for positioning the tool approximately, after which micrometer dials on the feed-screws of the turret and side-head are employed in turning and boring to the required dimensions, without any reference to calipers or hand micrometers. At the left, is seen a finished bearing as it leaves the machine.

The operation illustrated in Fig. 7 consists of machining a cast-steel cross-head on a Bullard vertical turret lathe. At the time that the photograph was taken, a tool on the side-head was engaged in turning the shank end of the cross-



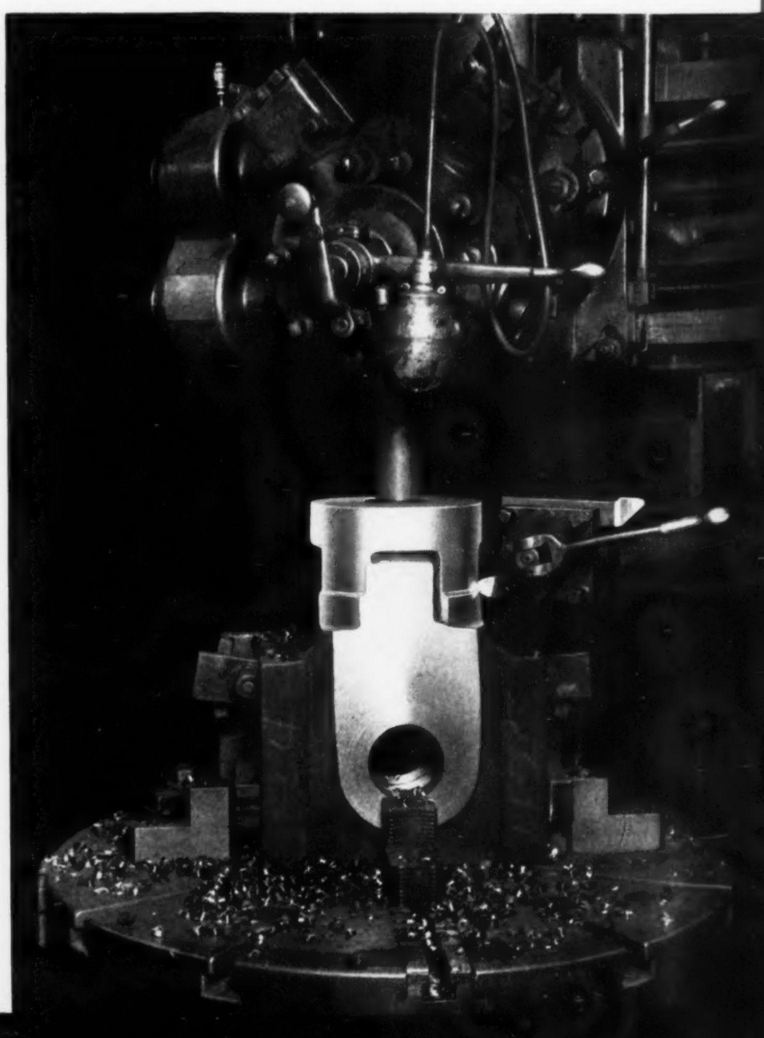
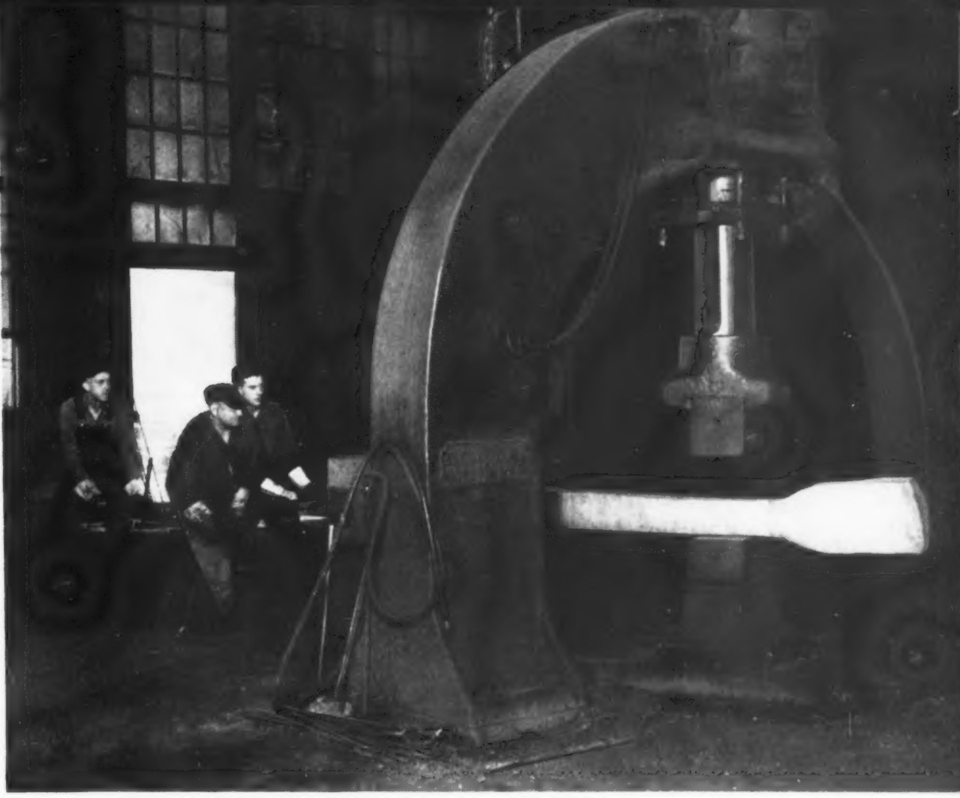


Fig. 8. (Right) Side-rods are Forged to Approximate Outlines by This 6000-pound Steam Hammer

Fig. 9. (Below Left) Reaming the Wrist-pin Bores of a Cross-head in a Reservicing Operation

Fig. 10. (Below Right) Milling the Contour of Two Side-rods in Accordance with a Scribed Outline



head while a tool in a boring-bar on the turret was being used for boring the taper piston-rod fit. The top end of the cross-head is also faced in this set-up. The large diameter of the piston-rod bore is about 4 inches as cast and 5 1/4 inches when finished. One side of the cross-head is clamped to an angle bracket to insure rigidity.

In a previous set-up on the same machine, the wrist-pin holes of the cross-head were bored and the four inner and outer sides of the yoke were faced. Roughing cuts are taken to a depth of approximately 3/8 inch in both operations, Rexalloy cutters being used.

The final step on the wrist-pin bores consists of reaming with a large helical inserted-blade reamer, such as shown on the Carlton radial drilling machine in Fig. 9. Cross-heads that have been in service are re-reamed on this machine rather than on the vertical turret lathe.

The reamer illustrated is 5 15/32 inches in diameter at the large end and 17 7/8 inches long; however, reamers as large as 6 1/4 inches maximum diameter and 24 inches in length are used.

The helical blades on the reamer shown are made up of seven sections each, and there are eight blades around the tool. In repair jobs, the practice is to remove from 1/64 to 1/32 inch of stock on a side. Accuracy of set-up in this operation is insured by the use of a fixture at the back of the machine base, which is provided with a bearing to receive an arbor, the front end of which has been inserted in the piston-rod bore of the cross-head. This insures that the wrist-pin bores will be reamed at right-angles to the piston-rod bore.

Side-rods are forged to approximate outlines from billets of steel preheated to a suitable temperature, and are then cut closer to the required shapes by oxy-acetylene equipment before being transferred to milling machines for finishing. A typical side-rod forging is seen in Fig. 8 on the anvil of a Chambersburg 6000-pound double-arch steam hammer. At the beginning of this forging operation, the billet measured 50 by 20 by 9 inches, and when the forging left the hammer, it measured 137 inches in over-all length and was 7 inches thick on the large end and 5 inches on the small end.

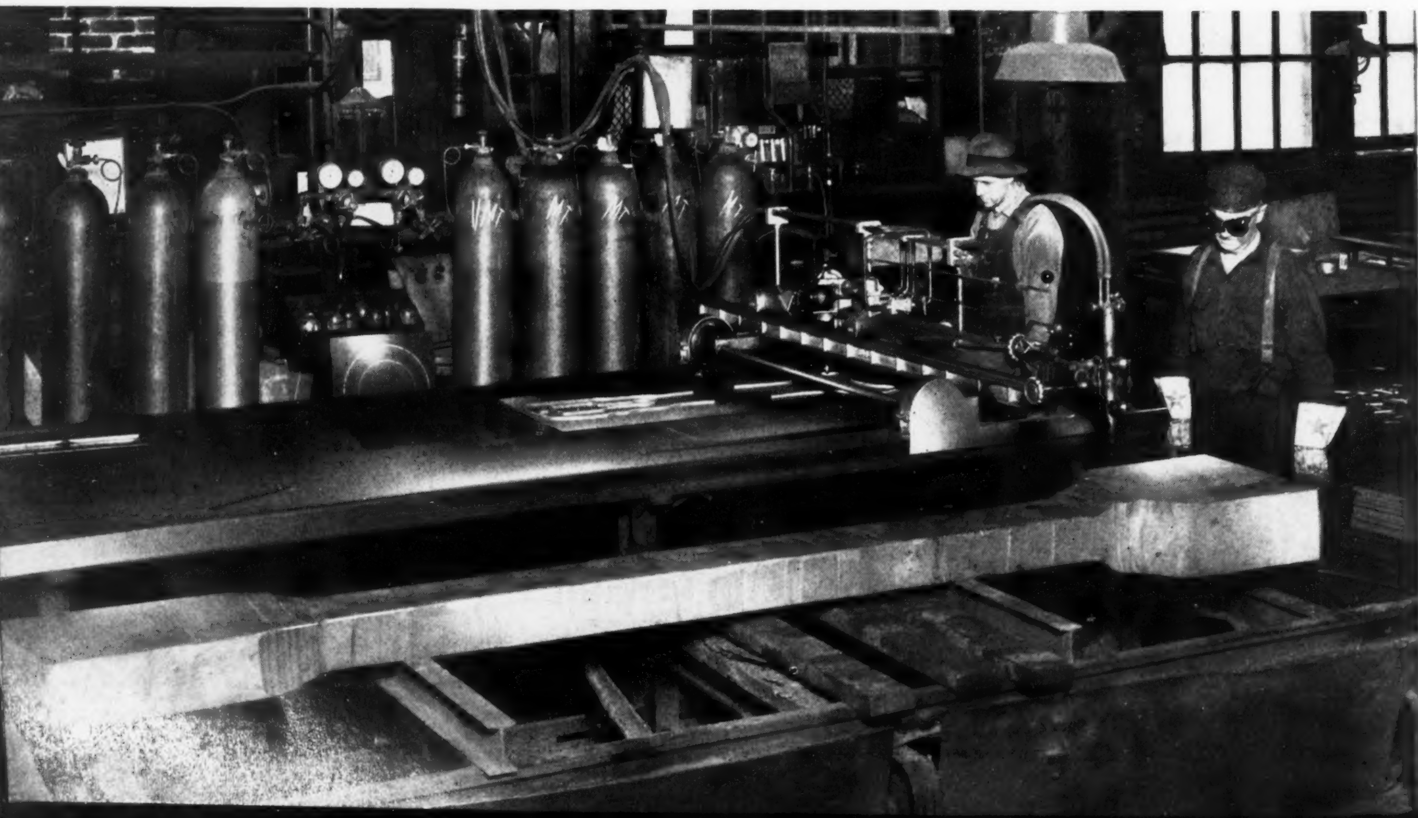
Oxweld cutting equipment used in the Beech Grove shop is seen in Fig. 11 set up to start cutting a side-rod to outside dimensions which allow stock for machining. In this operation, the torch is guided automatically along the work as a tracer moves around templets located on the large adjacent table, as shown. Not only the exterior contour of the rod is cut out by the oxy-acetylene torch, but also holes of the desired outlines in the two ends. The side-rods are preheated to 1050 degrees F. prior to this operation, and work up to 14 inches in thickness is handled.

A cutting machine similar to the one shown is provided on the opposite end of the templet table, so that two operations can be performed at one time on the same side-rod or on two different pieces of work. In addition to side-rods, cross-heads are cut to approximate shapes with this equipment. A similar machine is used in the car shop for cutting steel plates to the outlines required in car building.

Fig. 13 shows an Airco Oxygraph machine in the Collinwood shop engaged in cutting out the hole in one end of an intermediate side-rod that is required for a crankpin bushing. The tracer is held magnetically against a templet cut from sheet steel that is seen on the table at the left. This machine is also used for shape cutting cross-heads, and handles preheated work up to 14 inches in thickness.

The contour-milling of two side-rods after they have left the oxy-acetylene machines is

Fig. 11. Oxy-acetylene Equipment Set up for Cutting the Outline of a Locomotive Side-rod to Templets Seen Lying on the Table



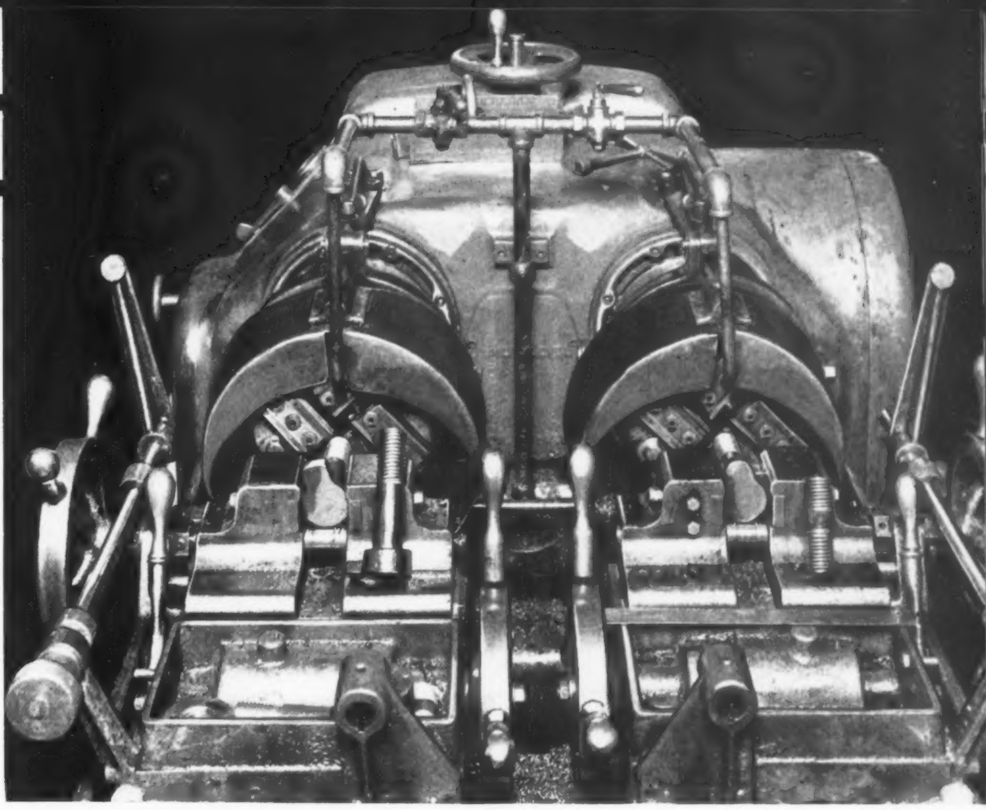


Fig. 12. Threading Pedestal Cap Bolts on a Machine Arranged with a Variable-speed Drive that Can be Closely Controlled

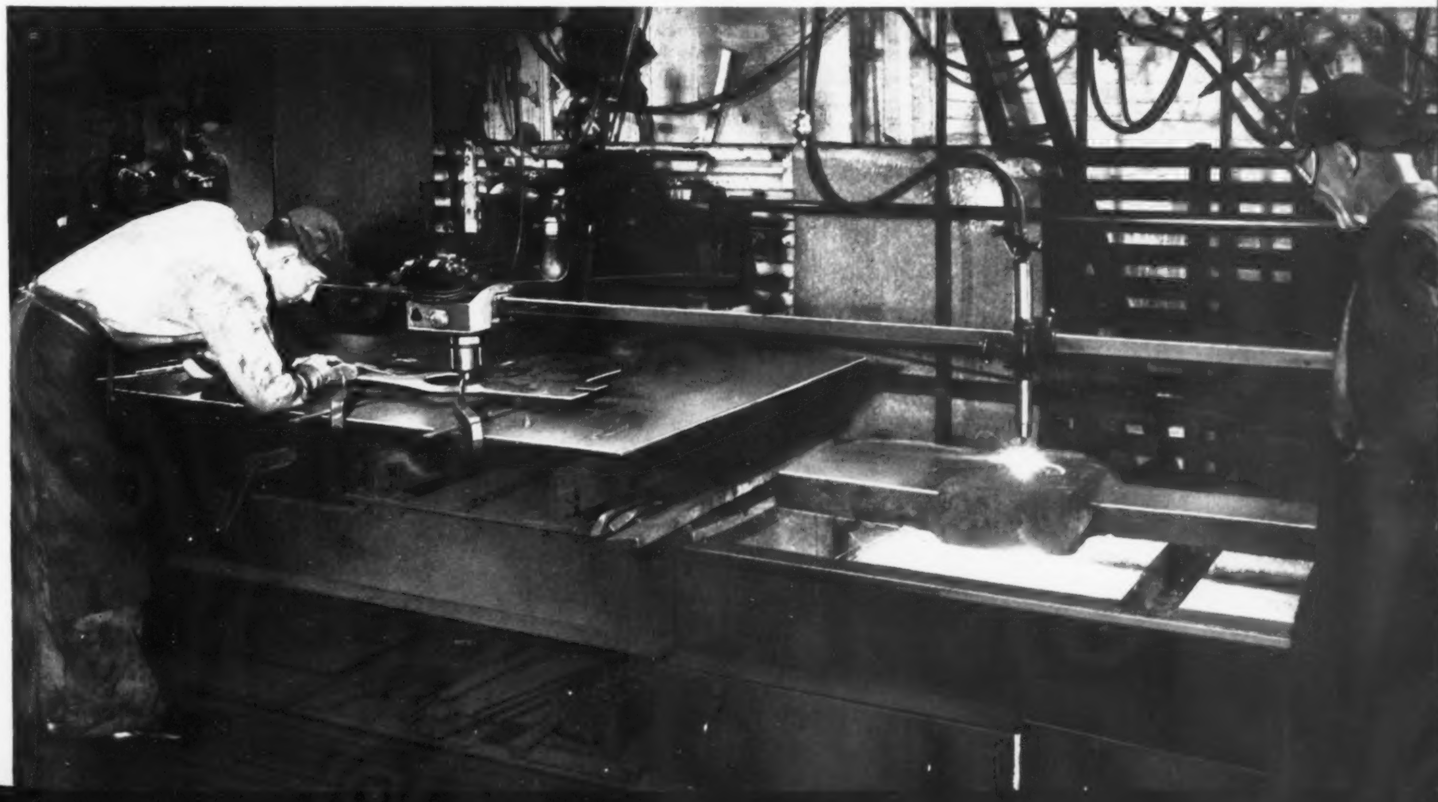
★

shown in Fig. 10 being performed on an Ingersoll vertical-spindle milling machine. The ends of the rods being milled are clamped in the center of the table and the overhanging ends are supported by a fixture attached near the edge of the table. In the operation, the rods are fed in or out or revolved around the cutter to secure the desired outline.

The double-head Murchey threading machine shown in Fig. 12 is used to produce several types of bolts and studs. When this photograph was taken, the machine was engaged in threading pedestal cap bolts. These bolts are 1 1/8 inches in diameter by 2 1/2 inches long, and are cut seven threads per inch. They are checked with a "Go" and "Not Go" gage.

An advantage of this machine is that it can be quickly changed from straight threading operations to taper threading, as on crown bolts. It is equipped with a V-belt drive and a variable-speed mechanism by means of which speeds can be controlled as close as within 1 R.P.M. There is a dial that indicates the exact speed at which the machine is running, a feature particularly useful in threading heat-treated stock. The speed is changed by merely revolving a handwheel.

Fig. 13. Another Oxy-acetylene Cutting Operation in which a Hole is being Cut in a Side-rod prior to being Machined to Receive the Crankpin Bushing



Diesel-Electric Switchers for

Why and How Industrial Locomotives are being Built by the General Electric Co. During the Present Emergency

By F. H. CRATON
Industrial Haulage Section
General Electric Co.
Erie, Pa.

★

DIESEL-ELECTRIC locomotives from 25 to 80 tons in weight are proving a boon to America's wartime industries by the advantages they afford in switching railway cars in and about manufacturing plants. They can also be utilized for transferring freight cars between points several miles apart. Of greatest importance, however, is the fact that Diesel-electric switchers can be operated twenty-four hours day in and day out and be available for actual service more than 95 per cent of the time. One Diesel-electric switcher can do almost as much work as two steam locomotives; in fact, one railroad company was able to release forty steam locomotives for general road service by the purchase of twenty-five Diesel-electric switchers.

Still another advantage of industrial locomotives of this type is the fact that they can be operated inside factory buildings without causing discomfort and annoyance from smoke. Around powder and shell loading plants and ammunition dumps especially, Diesel-electric locomotives minimize fire hazards.

Because of these advantages, several hundred Diesel-electric industrial locomotives have been supplied to industry since the United States started in earnest upon its armament program. A large percentage of these locomotives have been purchased by the War Department for use in various arsenals, and a considerable number by the Navy Department for service in widely separated naval bases. Several heavy-duty units are in use at the Panama Canal.

Another factor that has enhanced the popularity of Diesel-electric switching locomotives is the substantial increase in horsepower per locomotive that has been made possible in recent years, coincidental with an impressive reduction in cost. In 1935, for example, the "power plant" of a 65-ton Diesel-electric locomotive consisted of a single engine that developed 300 H.P. at 550 R.P.M., a main generator, and an auxiliary generator. In 1940, there became available for such a locomotive a Diesel engine that develops 200 H.P. at 1800 R.P.M. and a newly developed generator that embodied important improvements. Two such "power plants" can be sup-

plied for a locomotive of the same weight as the one mentioned, with an increase in horsepower at the wheels of 19 per cent and a reduction in power plant cost of 61 per cent, with the equipment actually installed on the locomotive. The reduction in over-all locomotive cost amounts to approximately 26 per cent.

These figures apply to Diesel-electric switchers built by the General Electric Co. in its Erie, Pa., plant, where Diesel engines of the type mentioned are provided on five sizes of locomotives ranging from 25 to 70 tons in weight. One, two, or four motors are supplied on a locomotive, depending upon the weight. The General Electric Co. regularly builds for stock Diesel-electric locomotives ranging from 25 tons, 150 H.P. to 80 tons, 500 H.P.

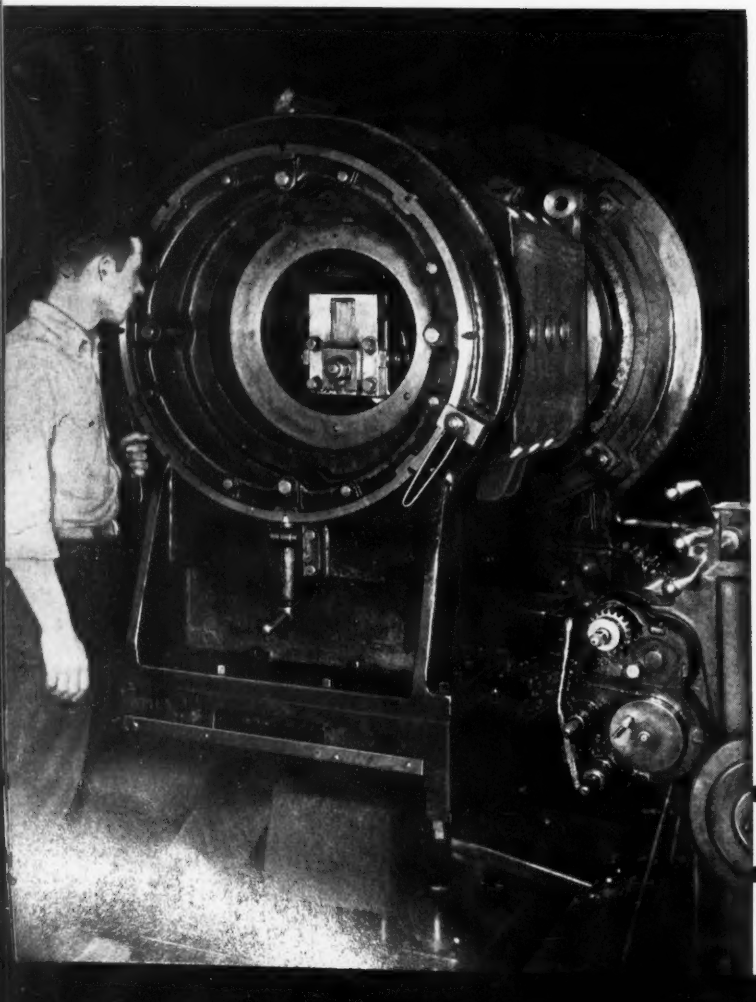
A general view of the shop in which these industrial locomotives are erected is shown in Fig. 1. The other illustrations in this article show typical operations performed in machining the various parts. Fig. 2, for example, shows a Gray planer set up for an operation on four motor frames for switcher engines. One cross-rail tool-head is mounted on a saddle member which can be swung to any required angle and locked in place for taking such cuts as those necessary in planing the joint faces of the axle bearings. The illustration shows this saddle set at an angle of 30 degrees. In addition to the joint faces, rabbet fits are machined on the inside of each bearing adjacent to the joint faces.

The tool on the other cross-rail head planes the gear-case lug on each frame, while the side-head on the right-hand column of the machine finishes suspension lugs. The setting of the tools to the correct height for the various cuts is facilitated by a templet clamped to one end

Fig. 1. Erection Shop in which Diesel-electric Switching Locomotives are being Rapidly Assembled to Meet the Urgent Needs of Wartime Industry

Fig. 2. Planing Four Motor Frames for Diesel-electric Locomotives on a Planer Equipped with a Special Head for the Finishing of Angular Surfaces

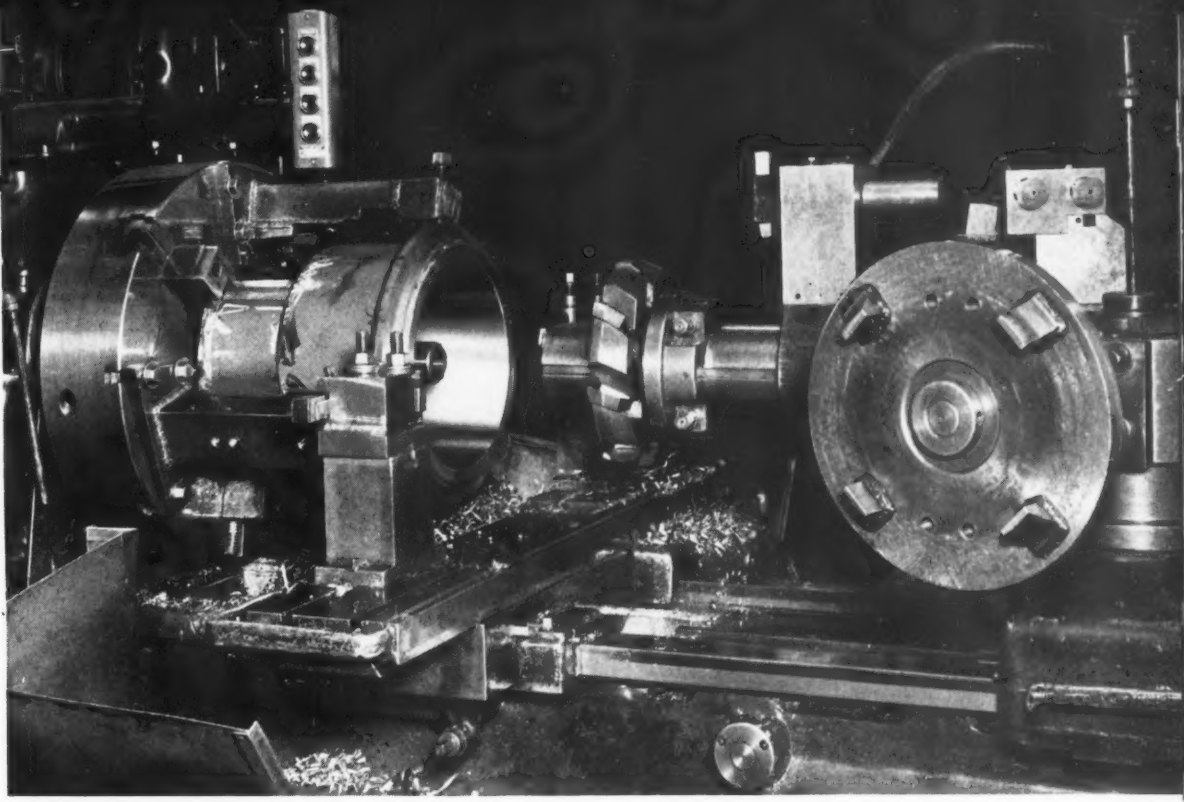
Fig. 3. Draw-cut Shaper being Employed for the Accurate Machining of Eight Coil Seats around the Inside of a Motor Frame for an Industrial Locomotive



of the fixture. A profile gage is employed in checking the rabbet fits.

Coil seats are finished around the inside of these motor frame castings on the Morton draw-cut shaper seen in Fig. 3. As the seats are machined in eight different planes, the fixture is provided with a convenient means of indexing. It will be seen that there is a notched index-ring at the front end of the fixture, the notches of which are engaged by a plunger below the ring which is fastened to the stationary fixture casting. The work-table is movable sideways for positioning the work relative to the cutter ram and to provide the required feed movements. The distance from a coil seat on one side of the motor frame casting to the coil seat directly opposite must be 28 inches within plus 0.008 inch, minus nothing, on the frame shown.

A Potter & Johnston chucking and turning automatic set up for machining generator frames is illustrated in Fig. 4. The chuck is provided with three built-up steel welded arms that extend forward about 18 inches from the faceplate to give the necessary support for the long overhanging work. Clamping screws are provided at the front ends of these arms. An alignment plate on one face of the turret is fed against the work in chucking, so as to hold the front end of the part central with the regular chuck jaws at the opposite end of the work while the clamping screws are being tightened. This centering action on the overhanging end is obtained by means of four fingers on the alignment plate which are tapered on one side to an angle of



30 degrees with respect to the center of the plate. The included angle of two opposed fingers therefore corresponds with the taper of common lathe centers.

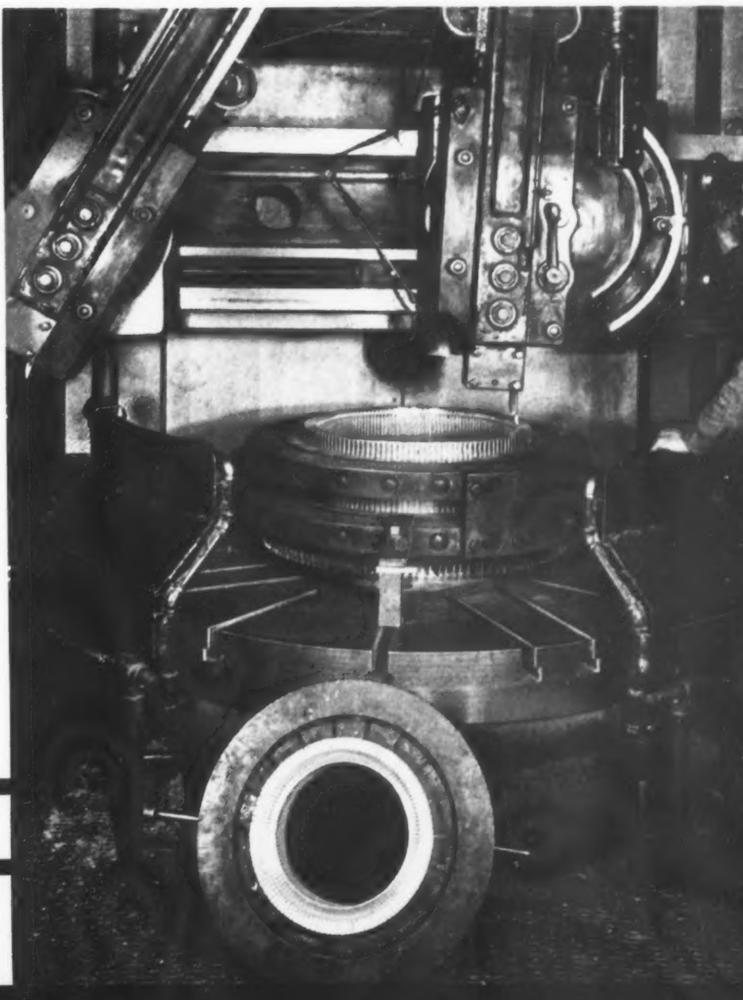
The first step in the operation consists of rough-boring with the large-diameter multiple cutter-head seen in line with the work. The eight cutters on this head are set to a diameter of 14.960 inches. At the same time that this boring cut is being taken, a tool at the front of the cross-slide is advanced to rough-face and rough-turn the shoulder or frame fit at the front end. When these cuts have been completed, a single-point tool mounted on the same turret face as the large boring head cuts a chamfer on the shoulder. The heavy boring head is rigidly supported during these cuts by a roller-bearing bushing in the center of the tool-bar which engages a pilot-bar extending from the headstock spindle in the center of the work.

After the turret has been indexed, semi-finish and finish cuts are taken on the bore by two tools mounted on one holder, one cutter being positioned slightly in advance of the other. These tools finish the bore to size within plus or minus 0.002 inch. There are two additional tools on the same turret face, one for turning a relief on the frame fit and another for semi finish-turning the frame fit. During these cuts, tools at the rear of the cross-slide finish-face the end of the generator frame and the fit surface.

The turret is indexed a third time to bring a cutter into position for finish-turning the frame fit to size within a tolerance of plus or

Fig. 4. Tooling Provided on a Large Automatic for the Accurate Machining of a Generator Frame Intended for Use on a Diesel-electric Locomotive

Fig. 5. Vertical Boring Mill with Two Heads which are Set up at Angles for Machining a V-groove in the Ends of Commutator Laminations



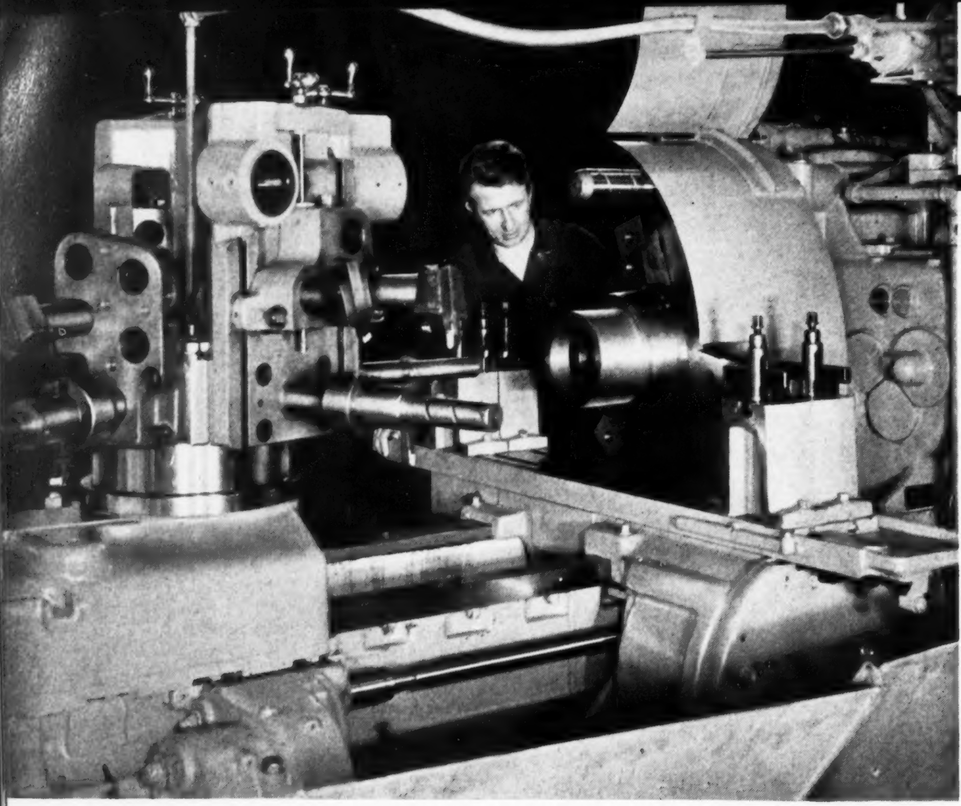


Fig. 6. (Left) Automatic Tooled up for an Operation on Commutator Shells to be Used on Motors for Diesel-electric Locomotives

★

Fig. 7. (Below) Producing Rotor Punchings for Locomotive Auxiliary Generators at the Rate of About 750 an Hour

minus 0.002 inch, the nominal diameter being almost 18 inches. The turret tools on the third and fourth stations are piloted similarly to the boring head in the second station.

Another type of Potter & Johnston automatic is shown in Fig. 6 equipped for an operation on commutator shells. The turret stations of this machine are provided with bushings that engage a pilot-bar on the headstock. When the work reaches this machine, it has been turned on one end, so that it can be accurately chucked.

The first step in this operation consists of rough-boring, rough-turning the cap fit, rough-turning the large diameter to a taper of 3 degrees, and rough-facing the front end, all of these cuts being taken with tools mounted on one face of the turret. The facing cut is taken with a wide single-blade slab cutter. After the turret has been indexed to the next position, finishing cuts are taken on most of these surfaces and, in addition, a form tool on the turret rough-machines a 30-degree recess in the front shoulder to receive a mica insulation ring.

Tools on the front of the cross-slide are next advanced for finish-facing the end of the part, the apex of the recessed shoulder, and the shoulder at the front of the large-diameter tapered surface. At the same time, tools on the third turret face semi-finish the cap fit, the 30-degree recess, and the bored surface. The fourth turret face is equipped with tools for finishing the 30-degree recess, the cap fit and the smaller diameter cylindrical outside surface. Another boring cut is also taken. Simultaneously, two tools at the back of the cross-slide finish-face the part to obtain the correct over-all length and finish-face the large shoulder. The final step in the operation consists of reaming the bore with a tool mounted on the fifth face of the turret.

In Fig. 5 is shown a King vertical boring mill engaged in machining a commutator for a generator after the commutator segments have been assembled into a ring type of fixture. The operation consists of facing the copper laminations, counterboring them, and machining a vee in the

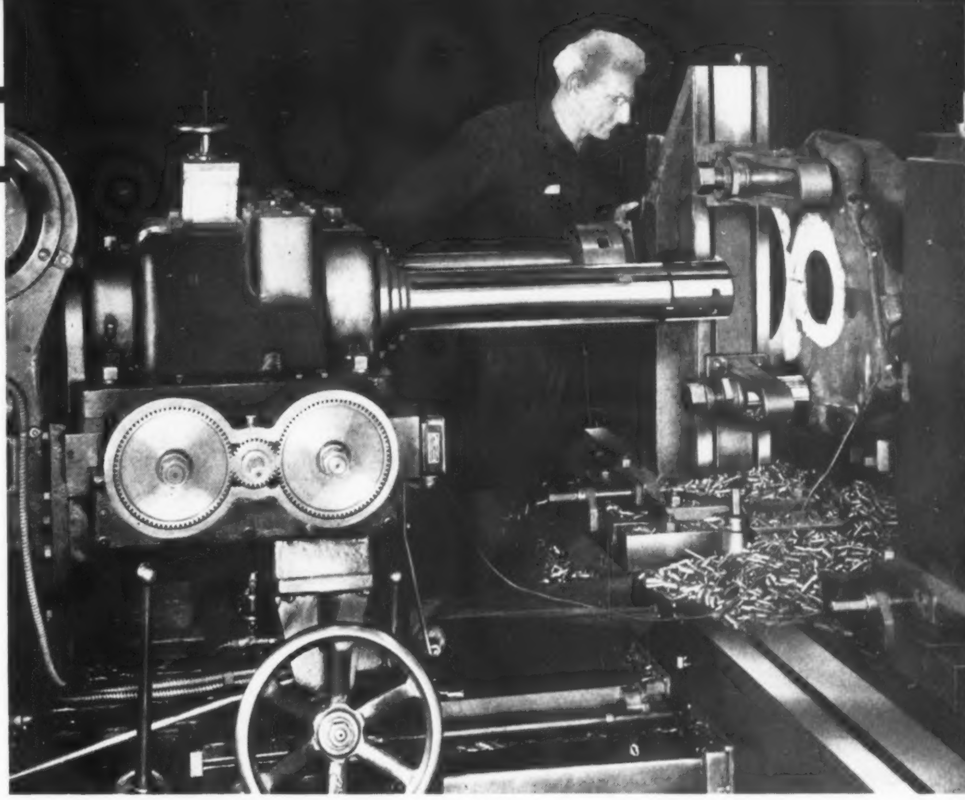


Fig. 8. (Right) Two-bar Boring Machine Designed for Machining the Openings in Gear Covers of Fabricated Construction

★

Fig. 9. (Below) Employing a Hydraulic Press of Vertical Design to Facilitate the Bolting of Caps to Commutator Assemblies

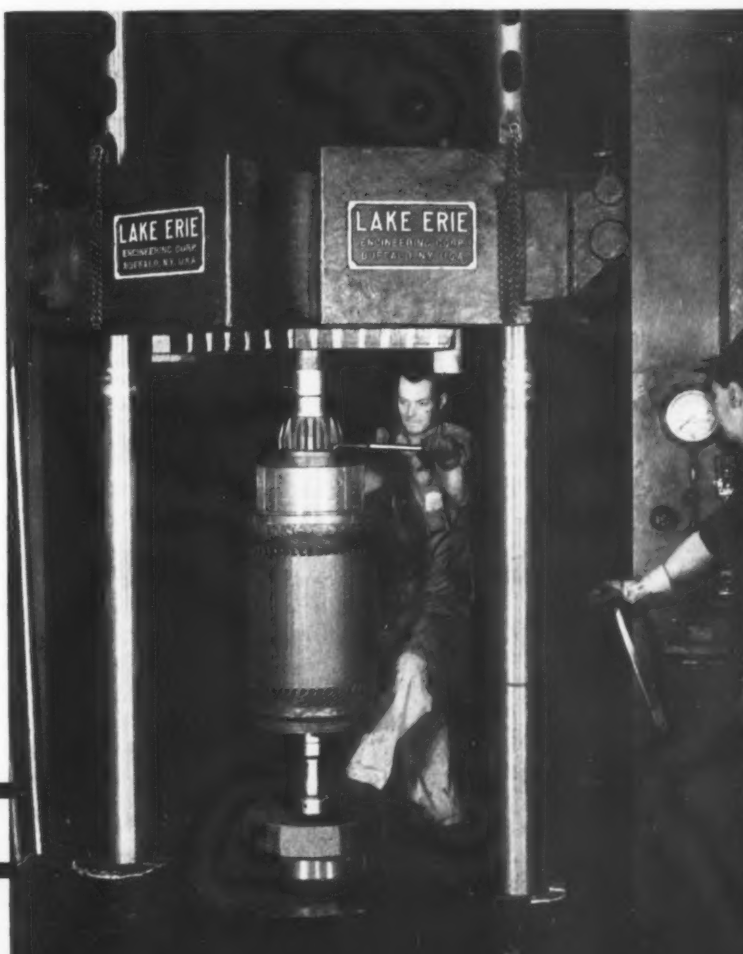
end of the counterbored laminations, as seen on the example at the front of the machine. One side of the vee is bored to an angle of 3 degrees by the tool mounted on the right-hand cross-rail head, and the other side is bored to an angle of 30 degrees by the tool on the left cross-rail head. The required angles are obtained by setting the tool rams accordingly on their saddles.

The commutator on the floor is not actually for a motor to be used on an industrial locomotive. It was placed there merely to indicate the design of the vee which, incidentally, later receives a mica insulation ring. Tolerances on the V-groove dimensions are plus 0.004 inch, minus nothing. Guards were erected around the table of this machine to confine the flying chips.

A Clearing 200-ton crankless press is seen in Fig. 7 producing rotor punchings for locomotive auxiliary generators. With one stroke of the press, a blank is produced having thirty-seven slots around the periphery, a comparatively large central hole with its keyway slot, and twelve surrounding holes. About 750 rotor punchings are produced per hour. The punch and die members are closely aligned by the use of pilot-bars. The die is spring-backed and acts as a stripper.

A Barrett two-bar boring machine built for simultaneously finishing two openings in gear covers is illustrated in Fig. 8. The required center-to-center distances of the bores are obtained by adjusting the boring heads transversely on the ways of the machine. An accurate stepped block is placed between opposite finished surfaces on the boring heads, as shown, to facilitate setting the heads the required distances apart. The split halves of the gear covers to be machined are bolted on top of each other for this operation by means of bolts inserted in holes previously drilled through lugs.

In the operation shown, the small opening was merely finished, as it had been cut in the cover sections before they reached the machine. The large opening, however, was cut from solid plate by the pointed right-angle tool on the rear boring head. The work is fed to the revolving tools



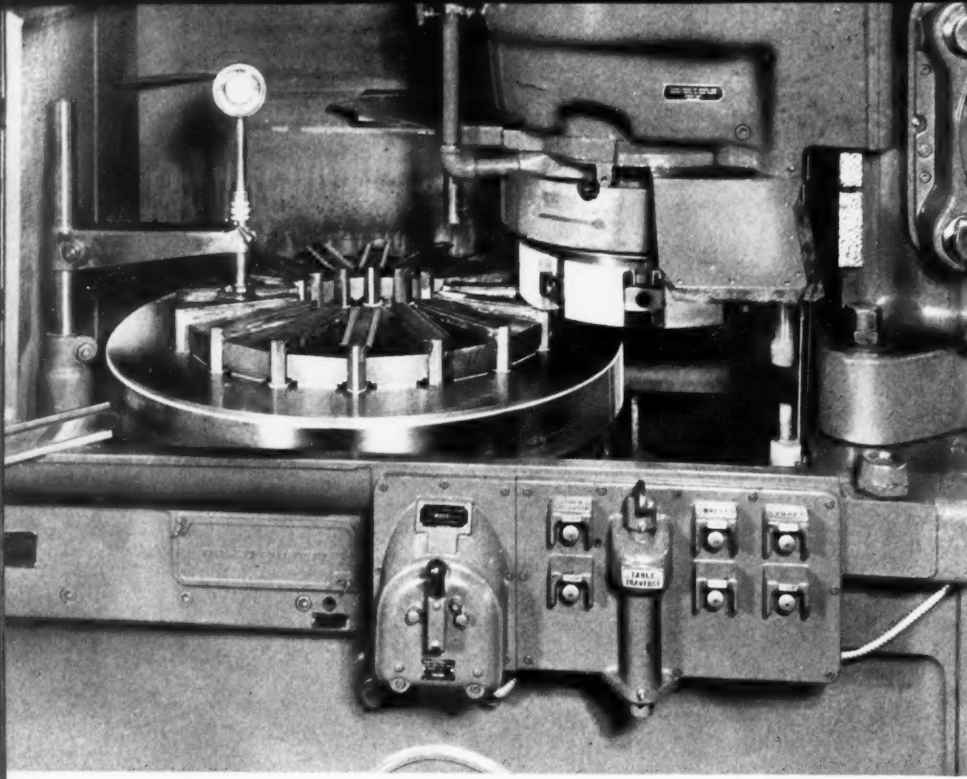


Fig. 10. (Left) Grinding Motor Pole Pieces on a Surface Grinding Machine, the Work being Held in Accurate Vertical Positions on the Magnetic Chuck by Wedge-shaped Blocks

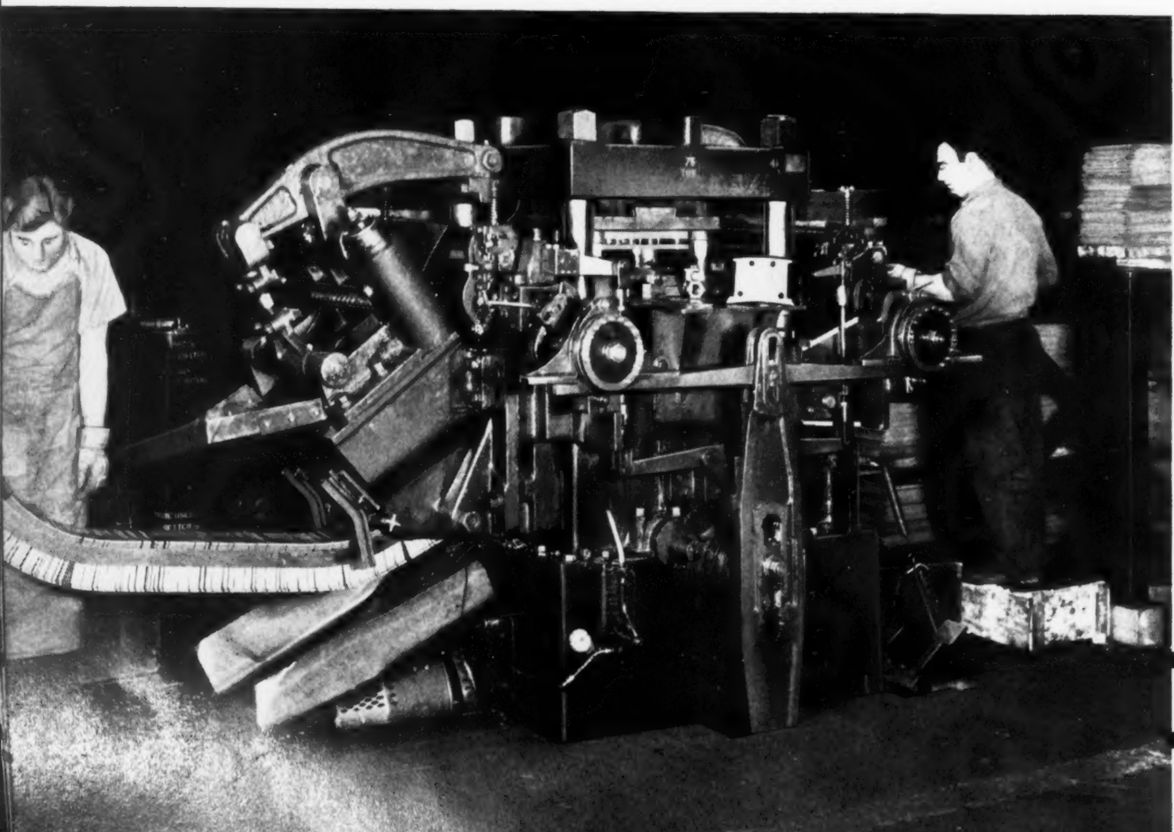
Fig. 11. (Below) Dieing Machine which Blanks Pole Pieces at the Rate of 120 per Minute through the Use of a Two-station Die

by the feeding of the table. Several hundred different jobs can readily be handled on this machine because of the universal fixture.

Caps are bolted to the commutator assemblies while held firmly on the mica insulation that is placed in the V-groove around the commutator laminations by the use of the Lake Erie 200-ton hydraulic press illustrated in Fig. 9. Pressures up to 50 tons are commonly employed on commutators for locomotive motors. With the pressure applied to push the assembly upward on a splined member known as a "crow's foot," the helper at the rear of the press tightens bolts to hold the cap in place. The press cylinder, which is located in the floor, is designed for a maximum piston stroke of 2 feet. The overhead anvil is supported on two posts 8 inches in diameter.

In Fig. 10 is seen a Blanchard surface grinding machine with a circular magnetic chuck used in grinding pole pieces, sixteen at a time. Wedge-shaped spacer blocks are employed to insure that the pole pieces will be held truly vertical, as the top and bottom surfaces must be closely parallel. The specified height of the blocks being ground is 2.820 inches, plus 0.002 inch minus nothing.

Pole pieces of the irregular outline seen on the table of the Henry & Wright 75-ton dieing machine in Fig. 11, and of approximately 8 3/4 by 5 3/4 inches in over-all dimensions, are blanked out by this machine at the rate of 120 pieces a



★

minute. The stock is sheet steel, 0.062 inch thick. The operation is performed by the use of a two-position progressive die. In the first position, four holes, 5/8 inch in diameter, are pierced, and in the second position, the irregular outline is blanked while the stock is accurately positioned by dowel-pins on the punch engaging the holes that were pierced in the first position of the die.

The blanked pieces pass down through the die and follow a chute that leads to the left, as seen in the illustration, where the operator removes them for stacking on skids. The blanks extend from the face of the die to the end of the chute, and thus back up the stock as each blank is sheared. In starting a new job, it is necessary to load up the machine and chute with pole pieces previously produced in order to provide the necessary support.

The scrap is cut up by the automatic shear at the end of the machine, and it slides down a chute to a tote box. The punchings from the pierced holes come down through a separate chute as they, too, are forced down through the die. Rolls feed the stock into the machine. The feed is 6 inches per stroke, which allows only 1/8 inch of scrap between successive pieces. The material for the job shown is 9 inches wide.

The main locomotive sections such as the under-frame and the cab bodies, as well as gear covers and many similar parts, are fabricated from steel plate by electric welding. Fig. 12 shows an end frame being fabricated in this manner. It is shown upside down. In setting up for such a job, the various structural members are clamped in the required locations and then tack-welded together. Later the welders deposit electrode material completely along all joints to obtain a strong water-tight construction. The deck plate on the under-frame illustrated consists of steel plate about 1/4 inch thick, but plates as thick as 2 1/2 inches are used for this purpose, the thickness depending upon the weight desired in the complete locomotive. The two I-beams that extend the full length of the under-frame are 15 inches high. This particular under-frame was designed for minimum weight and maximum distribution of strength. Heavier under-frames are considerably simpler in design.

Alternating current of 500 to 600 amperes is generally used in these welding operations in order to obtain a very high heat, or direct current of from 150 to 300 amperes; the lighter the material, the lower the current and heat used, so as to avoid distortion of the work.

Fig. 12. Electric Welding the Structural Members of a Locomotive Under-frame after the Various Pieces have been Tack-welded in Their Required Positions

Baldwin Locomotives for Long

Modern Methods Employed by a Century Old Concern in Building Locomotives to Meet Our Wartime Needs

By AMOS G. COLE
Works Manager, The Baldwin Locomotive Works

LOCOMOTIVES for the rapid mass transportation of the raw materials and finished products required in huge quantities by a nation at war are being rushed to completion daily at the Baldwin Locomotive Works, Eddystone, Pa. This is by no means a novel situation for the concern, as since the founding of the business in 1831, it has four times performed a similar national service—during the Mexican, Civil, Spanish-American and First World Wars. Its building of locomotives during such historic periods has proceeded at accelerated rates, while munitions of war were turned out at the same time in large quantities.

Steam locomotives have been the principal Baldwin product ever since "Old Ironsides" was built by the founder of the business, and engines of this classification have been sent to the four corners of the globe. Since 1893, however, the concern has also cooperated with the Westinghouse Electric & Mfg. Co. in building all-electric locomotives, Westinghouse providing the electrical equipment and Baldwin the locomotive proper. In 1939, to meet the growing demand for Diesel-electric switching engines, the concern added that type of engine to its products in two units of 660 and 1000 H.P. Many new machine tools were installed in the shop to meet the production operations necessary in the manufacture of Diesel engines. For these engines, too, Westinghouse electrical equipment is generally used.

This article will describe some of the operations followed in building both steam and Diesel-electric locomotives. Fig. 1 shows a machine engaged in turning one of the crankpins on a

Hauls and Switching Service

Diesel-engine crankshaft. The machine being used is designed on the principle of revolving the tools around the stationary crankshaft. If the reverse method were employed—that is, if the crankshaft were revolved—it would be necessary to provide means of turning it about the center of each crankpin. In the operation shown, the turning tool is mounted on an arm that is adjustable across ways attached to a revolving ring, 6 1/2 feet in diameter. Two tool arms are provided, so that two cutters can be applied simultaneously on a crankpin.

The tool-carrying ring revolves in a stationary housing. The housing is integral with a heavy slide which can be adjusted in and out on a carriage to obtain the desired transverse position of the tools with respect to the different crankpins on a crankshaft set up as shown. The carriage on which the slide is mounted can be moved longitudinally along the bed to locate the tools in position for turning the different crankpins and also for feeding the tools during the cutting operation.

After being rough- and finish-turned, the crankpins are burnished with rolls which are mounted on the tool arms in place of the turning tools. These rolls are 3 inches in diameter by 3/8 inch wide. They compress the crankpin exterior in a manner that eliminates all tool marks and considerably increases the hardness of the surface metal. After the rolling operation, the crankpins are polished with emery cloth held against blocks mounted on the tool arms. When a crankshaft leaves the machine, the crankpins must be to size within minus 0.001 inch, plus nothing. The nominal crankpin diameter on the crankshaft illustrated is 8.375 inches.

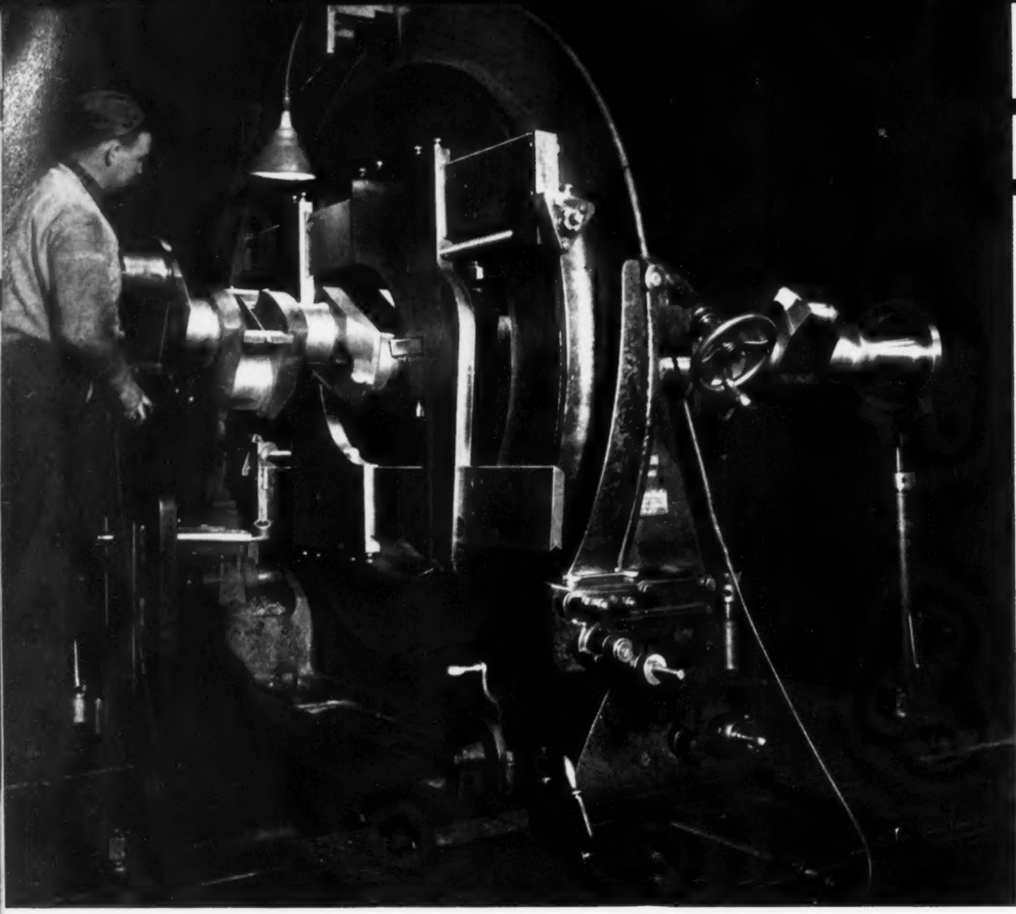
The main bearings of the crankshafts are rough-turned on large engine lathes before the crankpins are machined in the operation just described. After the crankpins have been finished, the crankshaft goes back to a lathe for semi-finishing the main bearings. Then it is sent to the Landis grinding machine shown in Fig. 2 for finishing the main bearings. Upon the completion of this operation, all the main bearings must be straight in line and parallel

within 0.001 inch, even though the crankshaft may be longer than 17 feet.

In order to insure attainment of this extreme accuracy, the foundation on which the machine rests is isolated on all sides and on the bottom from the regular shop floor by a 4 inch thickness of dry loose sand. The machine and its conventional rectangular concrete foundation, which is approximately 8 feet deep, literally float within a second foundation or tub which, in turn, is tied to the concrete floor.

In the particular operation shown, the crankshaft is slightly over 14 feet in length. The grinding wheel is 36 inches in diameter by 3 inches face width. The bed of the machine is 28 feet long.

The Diesel-engine frames and their bedplates



BUILDING BALDWIN

Fig. 1. (Left) Finish-turning Crankpins of a Diesel-engine Crankshaft on a Machine which is so Designed that the Tools Revolve around the Stationary Work

★

Fig. 2. (Below) Grinding the Main Bearings of a Diesel-engine Crankshaft in Accurate Alignment and Parallel

are of arc-welded steel construction, steel plate 3/8 inch thick being used principally in the fabrication of these weldments. After the parts have been tack-welded together while carefully positioned in jigs, they are completely arc-welded along all joints. These welding operations are performed by mounting the weldments on positioners, as shown in Fig. 4, which can be adjusted to place the different surfaces of the work so that electrode can always be deposited in horizontal planes. Six-cylinder Diesel-engine frames are seen on Ransome positioners at the right and left in the illustration, and a bedplate is shown on the middle positioner. Eight-cylinder frames, approximately 16 feet long by 5 feet wide by 6 1/2 feet high, are welded on the same positioners. All together there are about fifty positioners in the Baldwin shop, of both the Ransome and Cullen-Friestedt types. They are used in welding many other parts and subassemblies besides those mentioned.

For the welded fabrication of engine parts, the steel plate is cut to irregular shapes by the oxy-acetylene torch method, and this process is also employed in cutting out openings in the plates. Fig. 5 shows an Airco Travagraph machine provided with four torches for simultaneously cutting out four bearing support plates for Diesel-engine bedplates. The torches are moved in paths that correspond with a templet held on a table at the right of the machine, which is parallel to the work-table. The machine

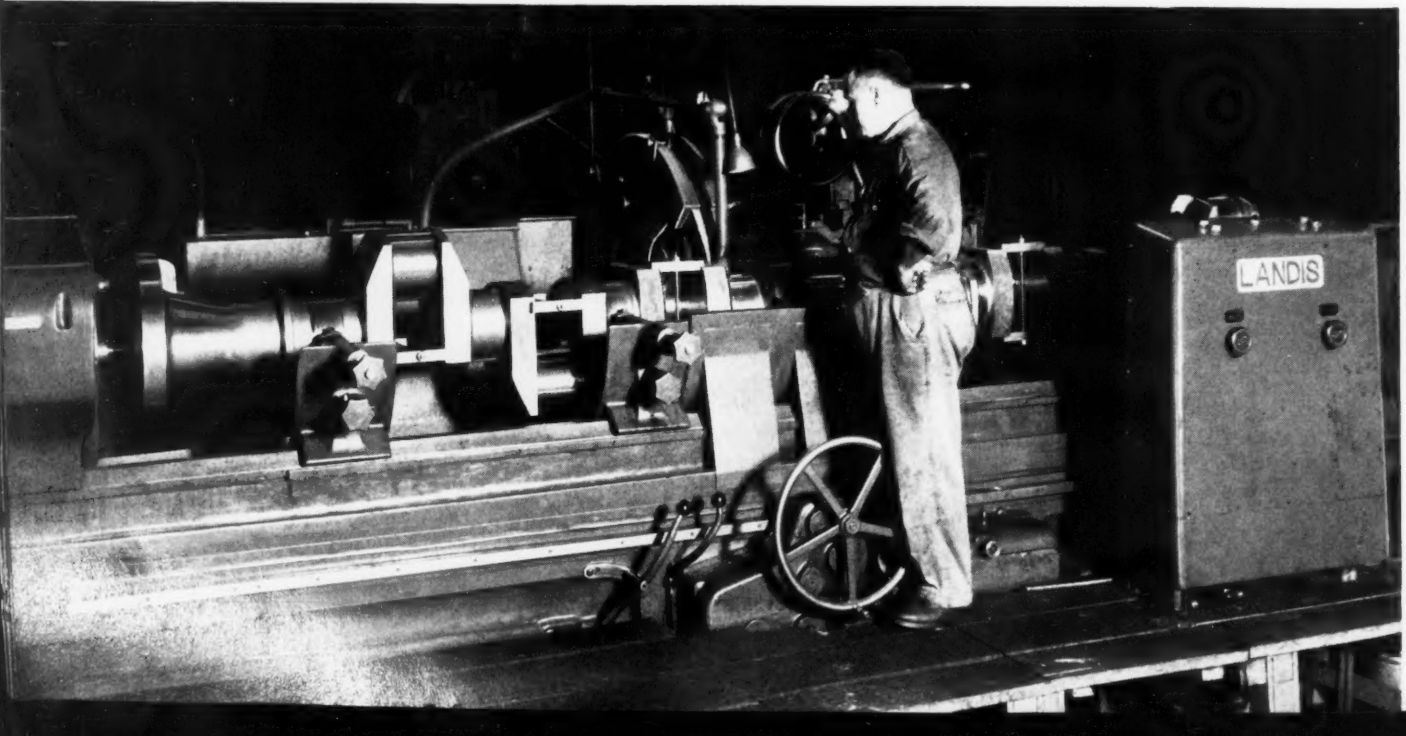
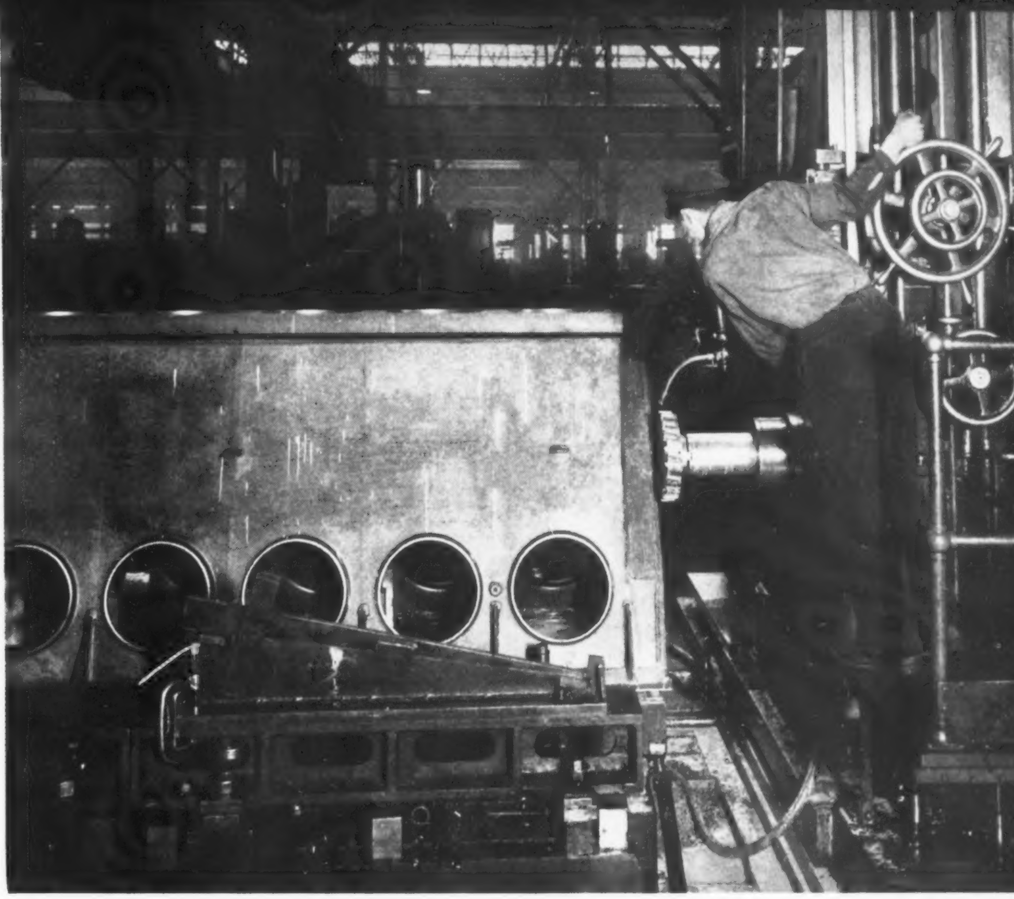


Fig. 3. (Right) Milling End of a Diesel-engine Frame Square with the Center Line within 0.002 Inch, to Obtain Close Contact between the Frame and Generator

★

Fig. 4. (Below) Welding Positioners Used in Arc-welding the Frames and the Bedplates for Diesel Engines



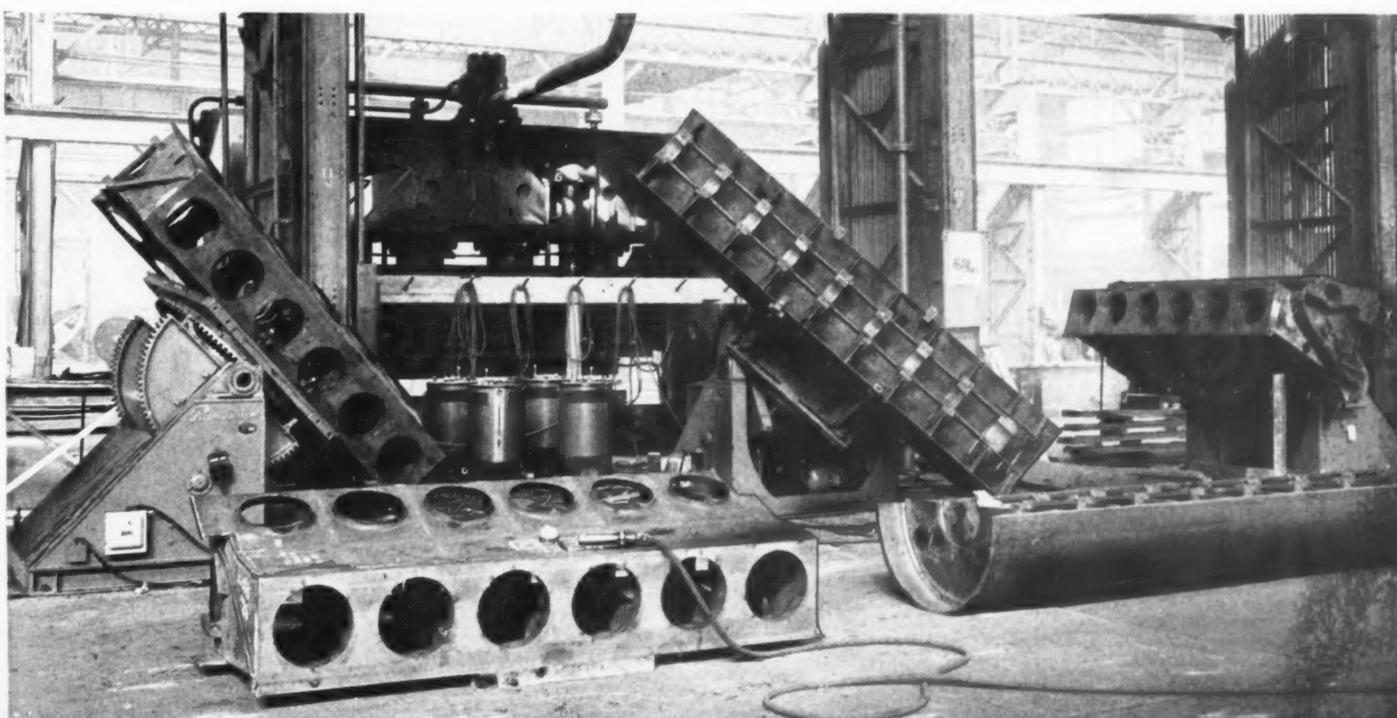
is traversed along tracks between the work and templet tables. Both tables have an area of 12 by 52 feet.

One of the engine frames is being face-milled in Fig. 3 on a Niles horizontal boring, drilling, and milling machine that is built with a 6-inch diameter main spindle and an auxiliary high-speed spindle. The cut in progress at the time that the photograph was taken consisted of milling the generator end of the engine frame square with the crankshaft bearings within 0.002 inch.

The frame is turned end for end on the bed of the machine for milling the other end, and later it is set up at right angles to the position shown, on two angular supports such as seen in front of the frame, for milling the inspection openings. The frame is also turned end for end on the angular supports so that the inspection openings on both sides can be milled.

The bedplates are brought to this machine for boring the crankshaft bearings by means of a long tool-bar that is supported on three brackets mounted on the bedplate. The generator flange on the bedplate is also machined by a facing head.

This boring mill is provided with a floor plate for the work which is about 24 feet square. Its concrete foundation is tunneled out to permit access to wedges, which can be adjusted in order to keep the table level. There is a coolant pit and pump beneath the floor plate to which all



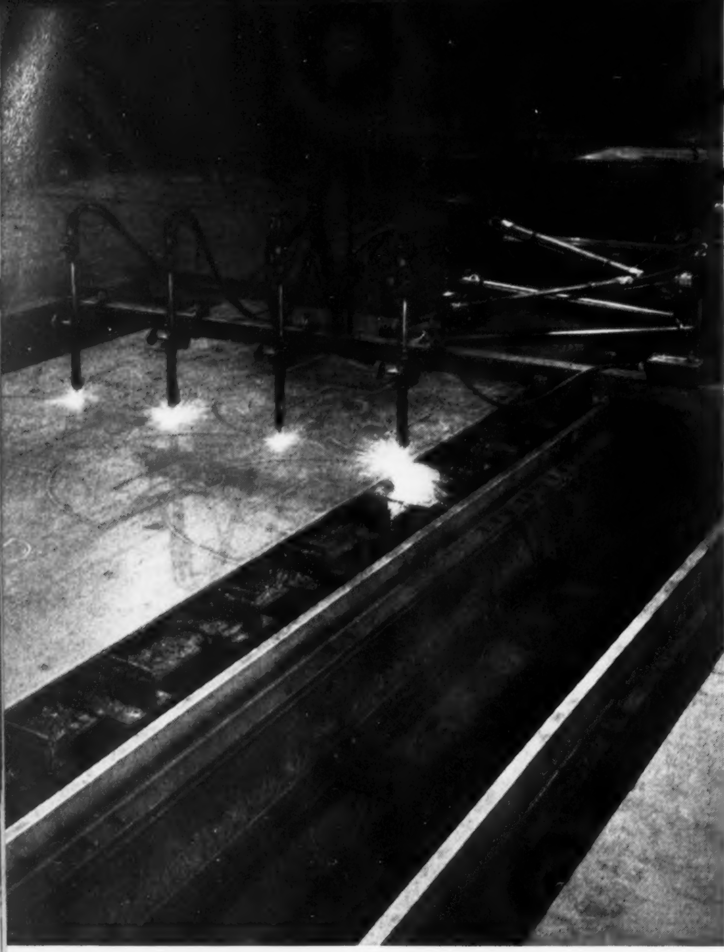


Fig. 5. Cutting out Support Plates for Diesel-engine Beds, Four at a Time, by the Oxy-acetylene Method

coolant drains. The column of the machine is fed and traversed along ways of a bed that extends the full width of the floor plate.

In Fig. 6 is seen a Warner & Swasey turret lathe set up for machining buffer castings. All the tools used in this operation are tungsten-carbide tipped. The first step consists of facing the front end of the casting with a tool mounted on the cross-slide. Then a tool on the first station of the turret is employed for rough-boring about half the length of the casting from the front end. Stock is removed to a depth of 1/4 inch, the head on which the boring-bar is mounted being rigidly supported by the engagement of a sleeve with a pilot bar on top of the headstock. The turret is then indexed to bring the tool on the next face into line with the work for finish-boring the same diameter.

The tool-head on the fourth turret face is next advanced for rough-boring the smaller internal diameter in the rear half of the casting. In this operation, a cut 1/4 inch deep is taken, and the tool-head is supported by the pilot bar which extends from the top of the headstock. Finally the tool-head on the fifth turret station finish-bores the smaller diameter. The two diameters are 7 5/32 and 8 9/32 inches. The part is a steel casting.

The application of an American radial drilling machine to an unusually accurate operation on connecting-rods for V-type Diesel engines is shown in Fig. 7. This operation consists of drilling and reaming bolt-holes that must be in unusually accurate relation to the crankpin bore and also to the finished faces at the crankpin end. Two fixtures are provided, the one at the right being designed for handling center connecting-rods, and the one at the left forked connecting-rods.

In both instances, the connecting-rods are located on the fixture by slipping the crankpin

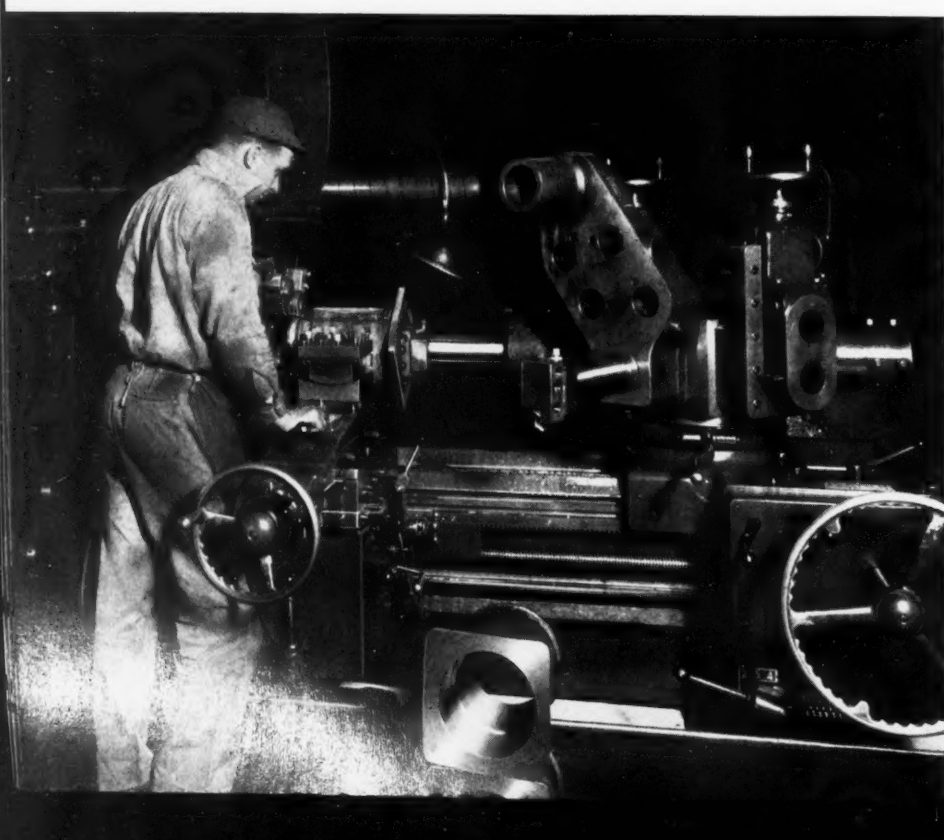


Fig. 6. Turret Lathe Operation in which Heavy Cuts are Taken on a Steel Casting by the Use of Tungsten-carbide Tipped Tools

★

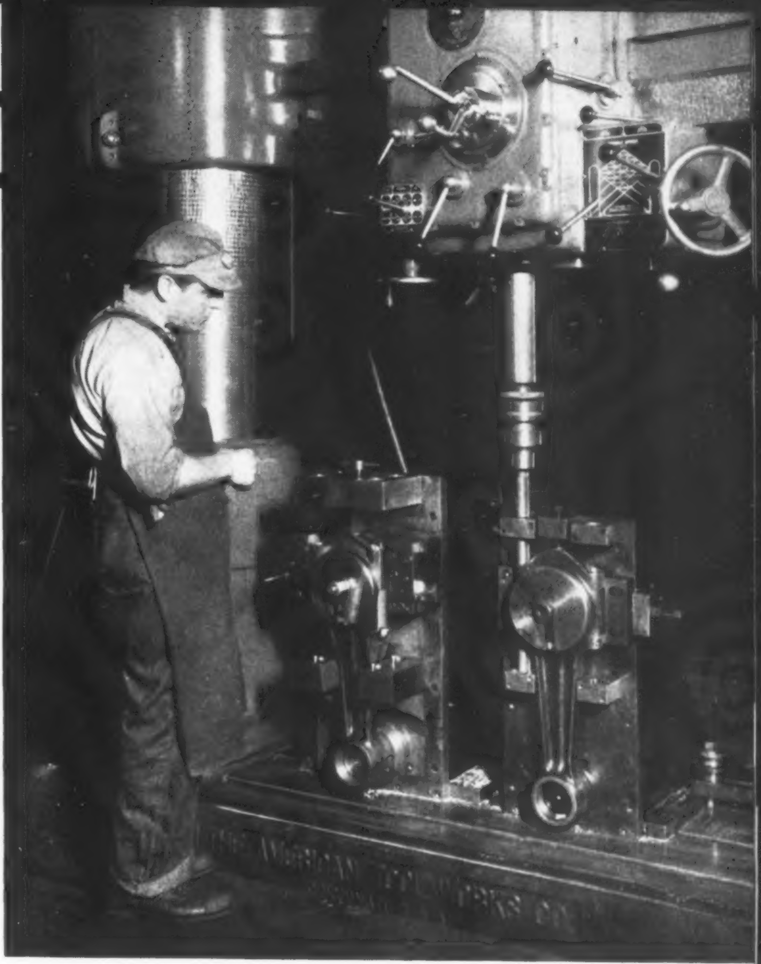


Fig. 7. Drilling and Reaming Bolt-holes in Connecting-rods in Accurate Relation to Crankpin Bearing and Face

and wrist-pin bores over plugs that extend from the face of the fixture. Adjustable blocks are tightened against the sides of the crankpin end of rods placed in the right-hand fixture, and then a C-washer is bolted against the front face of the same end. In the case of forked connecting-rods, held in the left-hand fixture, a round mandrel with ends of rectangular cross-section is placed crosswise through the fork to insure its proper location, the ends of the mandrel being inserted between the face of the fixture and blocks attached to the fixture. Sliding blocks are also adjusted against the forked end. Bushings at the top of the fixture guide the drills through the long connecting-rod lugs. In reaming, the long tool is guided below the work.

One of several Landmaco bolt threading machines recently installed for the production of Diesel-engine studs, locomotive-frame bolts, cylinder-head studs, and similar threaded parts required in locomotive construction is shown in Fig. 8. At the time that the photograph was taken, this 2-inch machine was engaged in cutting threads to a Class 3 fit on both ends of main bearing studs for Diesel engines. The threads are 1 1/2 inches in diameter, twelve per inch. They are 2 3/16 inches long at one end of the bearing stud and 1 13/16 inches long at the opposite end of the stud.

Threads are regularly cut on this machine concentric with the body within 0.001 inch by the use of ground chasers having a centering throat, and by gripping the body of the bolts in serrated blocks mounted on the carriages. The serrations of these blocks are ground and polished, so as to avoid marring the bolts. The lead-screw of the machine insures accuracy of thread pitch.

Additional operations in building locomotives in the Baldwin plant will be described in a second installment of this article.

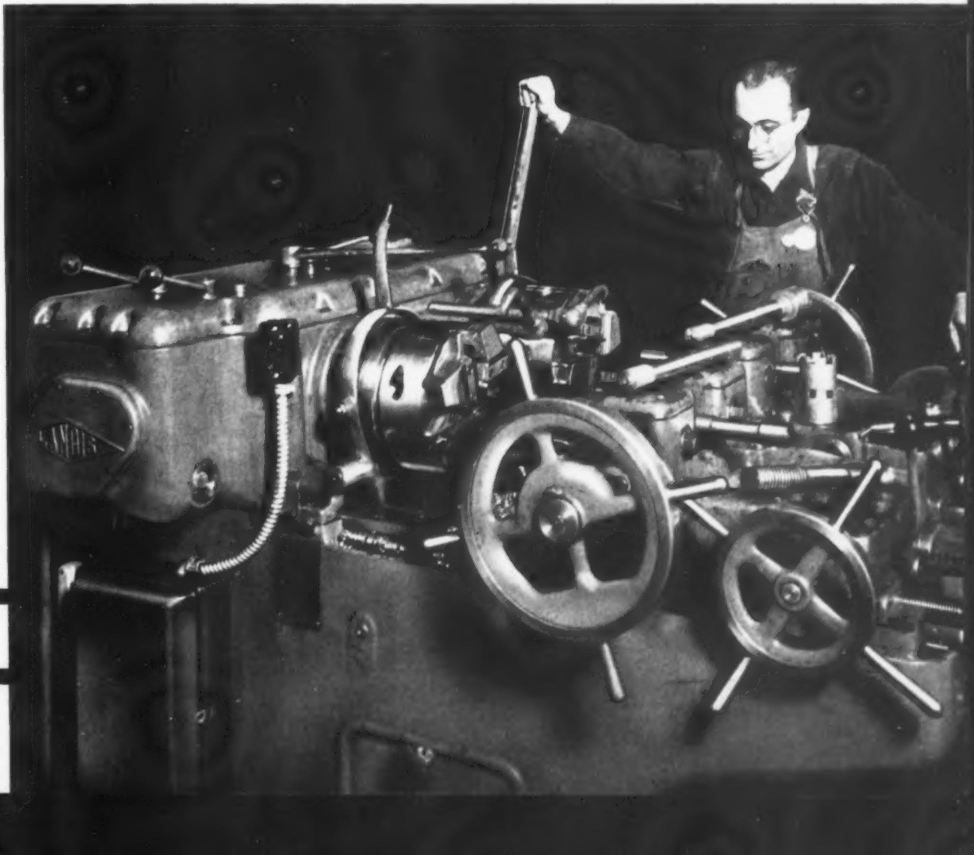


Fig. 8. Stud Threading Operation on a Machine that Insures Close Concentricity between the Threads and the Body of the Part

★

The Santa Fe Wartime

Fig. 1

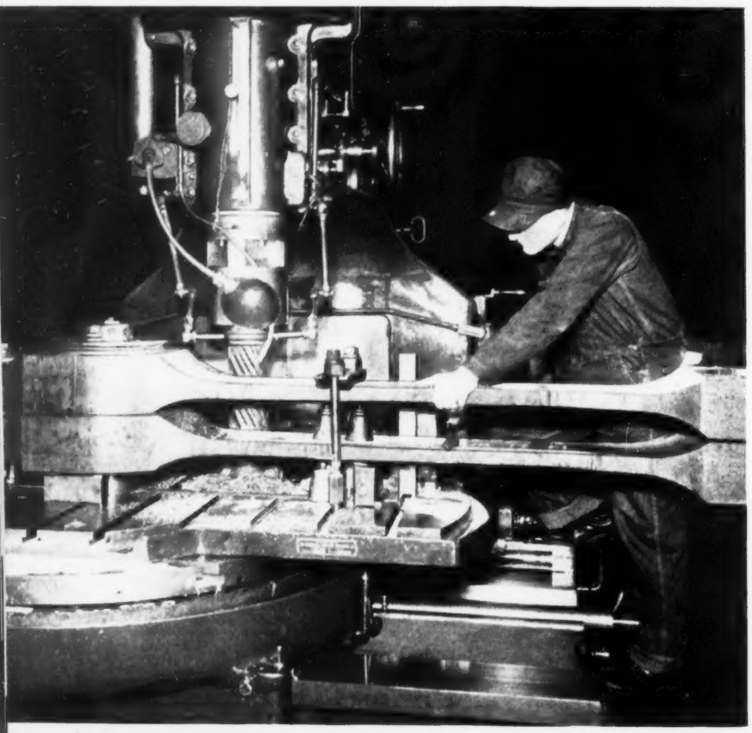
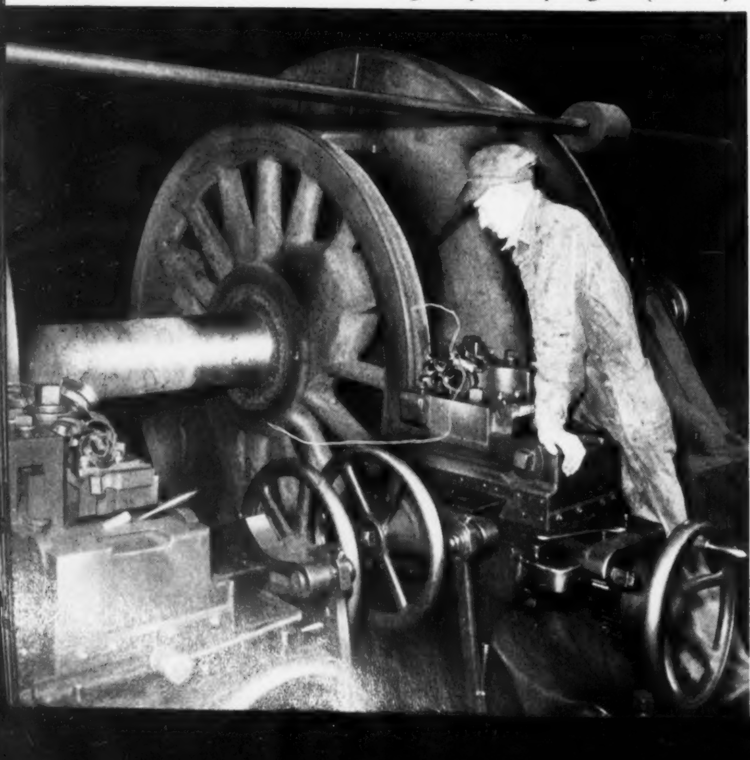


Fig. 2 (Above) Fig. 3 (Below)



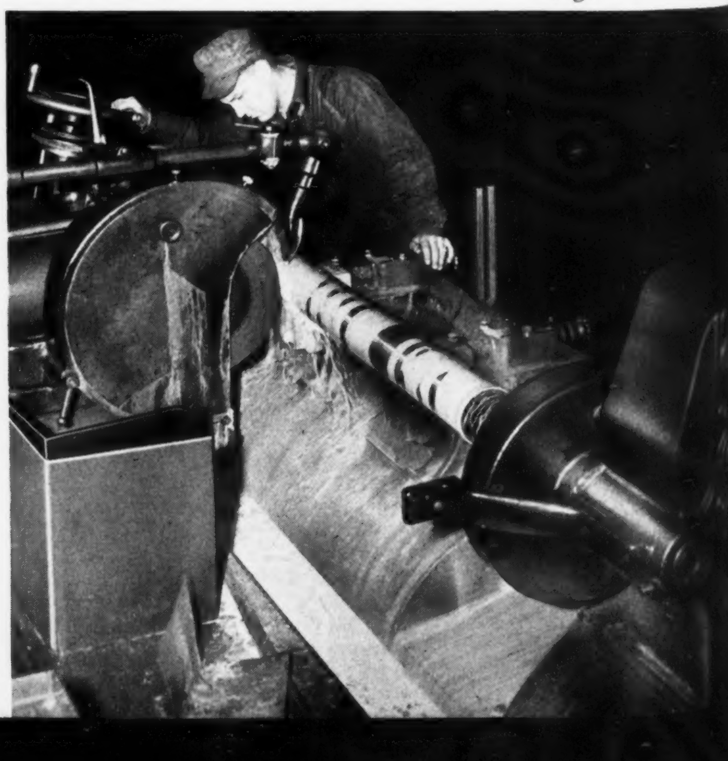
MAINTENANCE and repair operations are of ever increasing importance in the tremendous effort now being made by American railroads to raise their capacity to the unprecedented levels needed in the critical period ahead. One of the key railroads in the war effort, the Santa Fé, has all of its shops working at capacity, with the sole objective of keeping idle equipment down to a minimum. Operations in various shops are shown in the accompanying illustrations.

In the Diesel-electric locomotive shops in Chicago, a 260-ton capacity Whiting hoist (Fig. 1) lifts a passenger engine weighing approximately 155 tons from its trucks while repair men make an inspection.

Fig. 2 shows molybdenum side-rods for a steam locomotive being milled on an Ingersoll vertical milling machine. The 18-4-1 high-speed steel cutters used are 4 inches in diameter. For this job, a cutting speed of 26 R.P.M. is used, with a feed of 3/4 inch per minute.

Locomotive driving wheels ranging from the largest to the smallest in size can be turned on the 90-inch Niles wheel lathe in Fig. 3 recently installed in the Topeka locomotive shops. It is equipped with two tool turrets. The lathe is so mounted as to be free from any vibration of the floor. High-speed 18-4-1 tools are employed.

Fig. 4



Prepares for Traffic

The finish-grinding of a piston-rod for a steam locomotive on a Landis grinding machine is shown in Fig. 4. This machine has a swing of 26 inches and a maximum distance between centers of approximately 96 inches.

In Fig. 5, driving wheel tires are being bored on a Betts 100-inch vertical boring mill to suit each individual wheel center. A cut 1/4 inch deep, with a feed of 5/32 inch, is taken at a speed of 20 feet per minute. The tires are then heated with natural gas to expand them for mounting on the wheel centers.

The production of box and refrigerator cars is speeded up by the use of the Cincinnati press brake shown in Fig. 6, which is employed for producing a variety of metal shapes.

Two molybdenum main-rods for steam locomotives are being fluted on the Ingersoll horizontal milling machine shown in Fig. 7. Inserted high-speed steel cutters are used to take a depth of cut ranging from 1/8 to 1 inch. A feed of 1 7/8 inches per minute is used. Filleting cutters made from 18-4-1 high-speed steel are also used to produce a smooth finish on each rod.

A Micro internal grinder is being used in Fig. 8 for grinding the cylinder of an 8 1/2-inch compound air pump. An indexing table is provided on this machine, so that both ends of the pump can be ground with one set-up.

Fig. 5

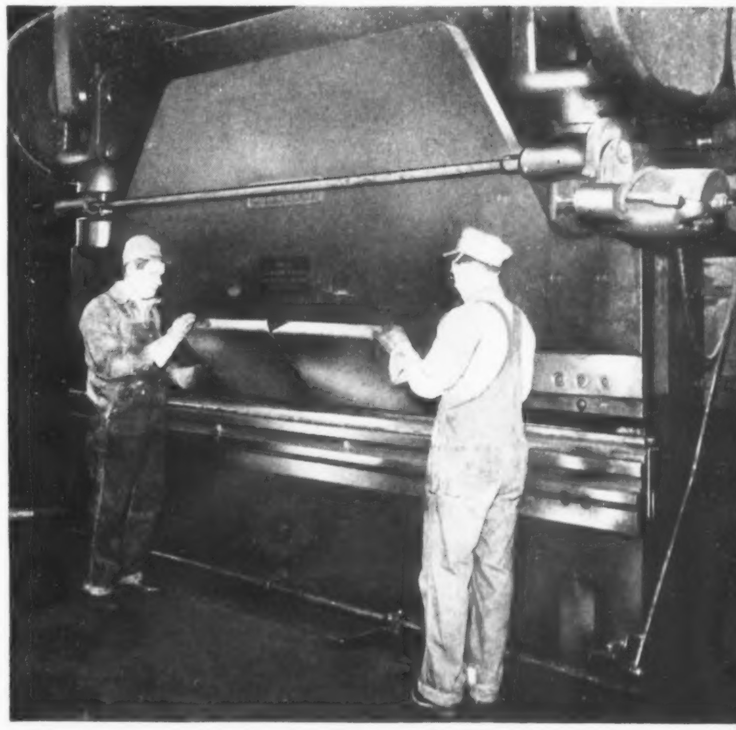


Fig. 6 (Above) Fig. 8 (Below)

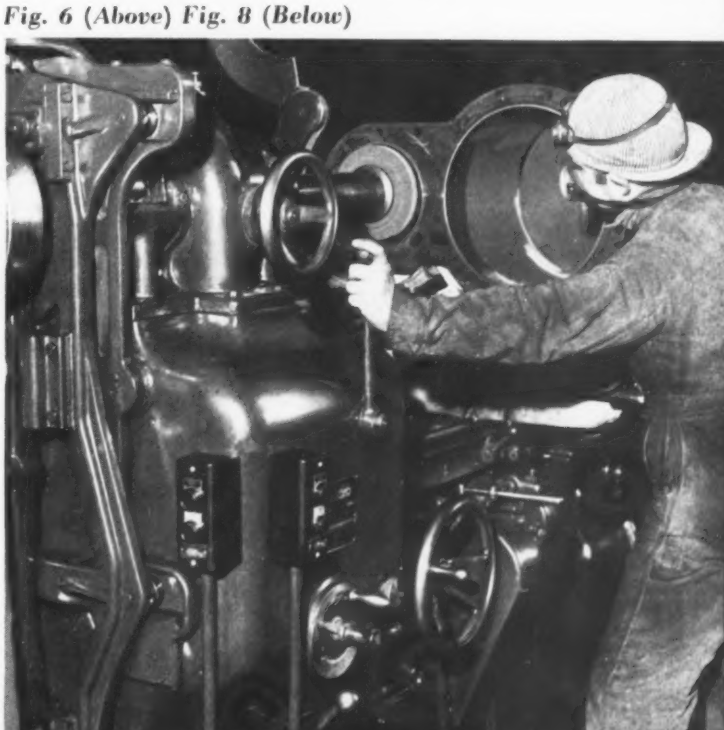
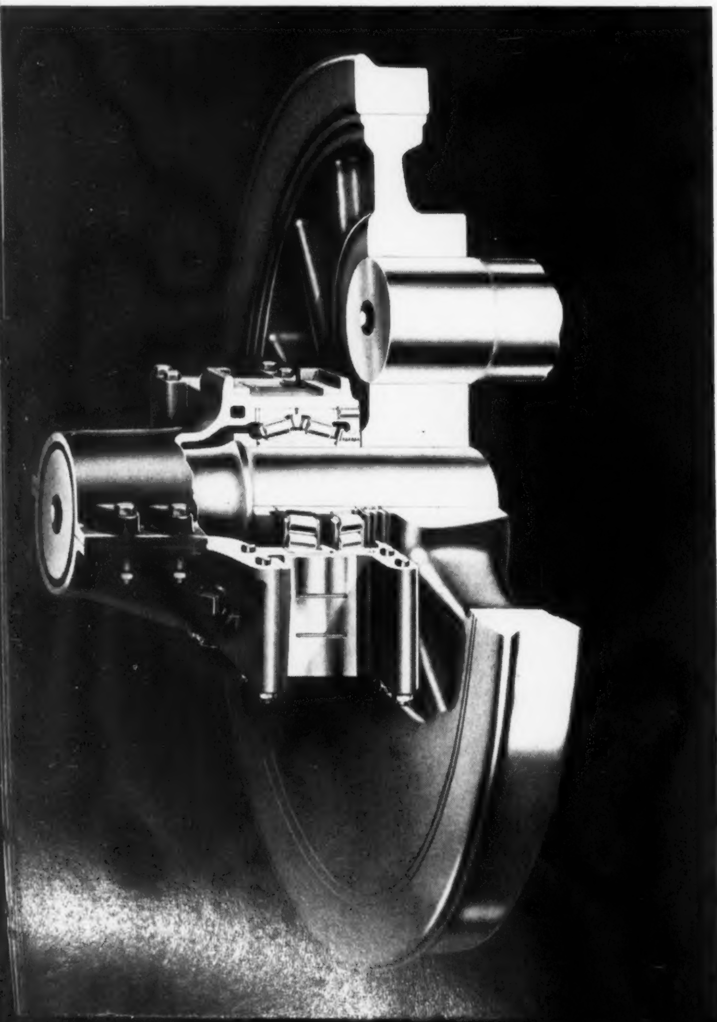


Fig. 7

Timken Tapered Roller Bearings

By WALTER C. SANDERS
General Manager, Railway Division
The Timken Roller Bearing Co.

NINETEEN years ago the Timken Roller Bearing Co., Canton, Ohio, pioneered in the use of roller bearings for railway cars and locomotives. So confident were Timken engineers of the advantages that could be derived from roller bearings in this class of service, that in 1927, the company had a locomotive built which was equipped with Timken tapered roller bearings on all axle journals. Tests performed on this locomotive by leading railroads from coast to coast quickly convinced railway officials that roller bearings would greatly reduce many of their operating and maintenance problems. Today most railroads have applied roller bearings to both locomotives and passenger cars and some of them to high-speed freight cars. Over 2000 locomotives have been equipped with Timken tapered roller bearings.



Streamline trains are equipped with roller bearings because they remove all speed restrictions, as far as the bearings are concerned. For several years, all new Pullman cars have been equipped with roller bearings. With our wartime problem of transporting quickly more munitions and commodities than ever before, the ability to run trains, especially freight trains, at faster speeds becomes vitally important. An even greater advantage of roller bearings on railway rolling stock, however, is derived from the fact that the use of roller bearings has increased the availability of locomotives approximately 70 per cent. In other words, locomotives make at least 70 per cent more mileage in a given period of time after being equipped with roller bearings than when plain journal bearings are used. A 42 per cent reduction in maintenance expense has also been accomplished.

Delays in transportation resulting from hot boxes have been eliminated by using bearings of this type, and they reduce the starting resistance of railroad equipment by 88 per cent. On locomotives so equipped, the life of running parts is prolonged and the engines have an increased hauling capacity. There are still other advantages that could be mentioned, including fuel economy and passenger comfort.

Fig. 1 shows a typical Timken bearing arrangement for the driving axles of steam locomotives. It has a split type tubular housing which can be applied to both existing or new locomotives. The bearing is of two-row construction. Double-row bearings are also provided on Diesel-electric locomotives and the passenger cars of high-speed trains. In Fig. 2 is shown a four-row or "Quad" application suitable for use on locomotive tenders and passenger car trucks. This bearing can also be fitted to existing, as well as new equipment.

Cones for locomotive driving axle bearings are bored and partly turned by the Potter &

Fig. 1. Split Type Tubular Housing with Double-row Timken Tapered Roller Bearings Designed for Application to Steam Locomotive Main Driving Axles

Speed up Railway Transportation

Johnston automatic illustrated in Fig. 3, which is equipped with a four-sided tool turret and air-operated chucks. The forgings come to this machine in the rough. The first operation consists of rough-boring the large internal diameter and rough-turning several surfaces on one end, all of these cuts being taken by tools on the face of the turret that is seen indexed toward the work. At the same time, the overhanging end of the cone is faced by a tool mounted on the front of the cross-slide.

After the turret has been indexed to bring the tools on the second face toward the work, these tools are applied for finish-boring the large diameter and for rounding the corner at the end of the bore. At the same time, the tool at the rear of the cross-slide finish-faces the cone. Carbide-tipped cutters are used for all cuts except corner-rounding. In roughing, cuts are taken to a depth of 3/16 inch at a surface speed of 200 feet a minute, the feed being 0.020 inch per revolution of the work. The bore diameter of the particular cone shown must be 12.517 to 12.527 inches when the cone leaves the machine. Accurate alignment of the turret tools for the two steps of the operation is insured by guide bushings on the turret which engage long cylindrical pilot bars extending from the headstock.

The bearing cones are next transferred to another Potter & Johnston automatic of the same type, which is tooled up, as shown in Fig. 4, for machining the external surfaces of the cones. This machine is also provided with air-operated chucks and tungsten-carbide tools. In the first step of the operation, four tools on one of the turret faces break down the scale on all cylindrical surfaces to be machined, and a cutter on the front of the cross-slide rough-faces the end of the cone opposite that previously finished.

After indexing the turret, all the cylindrical surfaces are rough-formed by means of a circular form cutter at the front of the cross-slide, similar to the one seen in the illustration at the rear of the cross-slide. At the same time, a cutter on the bar attached to the side of the turret seen facing the headstock is advanced for under-cutting a shoulder near the middle of the cone.

Finally, all external cylindrical surfaces are finish-formed by the form cutter at the rear of the cross-slide. At one side of the form cutter is a single-point tool which finish-faces the end of the cone. At the same time, two cutters mounted on the third turret face finish under-cutting the shoulder in the middle of the cone and round the corner of the bore. The finished length of the cone is 6.750 inches. Upon the completion of this operation, the cones are carburized and hardened, and they are then finish-ground and honed within exceedingly close tolerances. These cones, as well as cups and rings for railroad bearings, are forged from Timken railroad-bearing steel. Incidentally, bearings employed for railway applications range up to approximately 24 inches outside diameter.

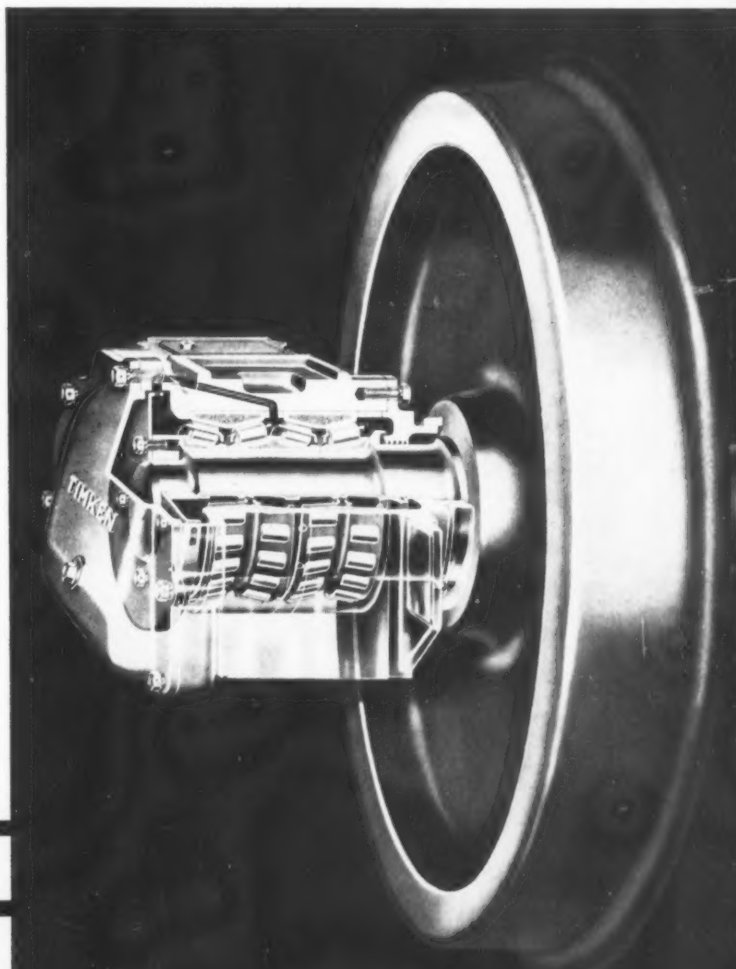


Fig. 2. Four-row Quad Type Timken Tapered Roller Bearings in Housing Designed for Application to the Trucks of Locomotive Tenders and Passenger Cars

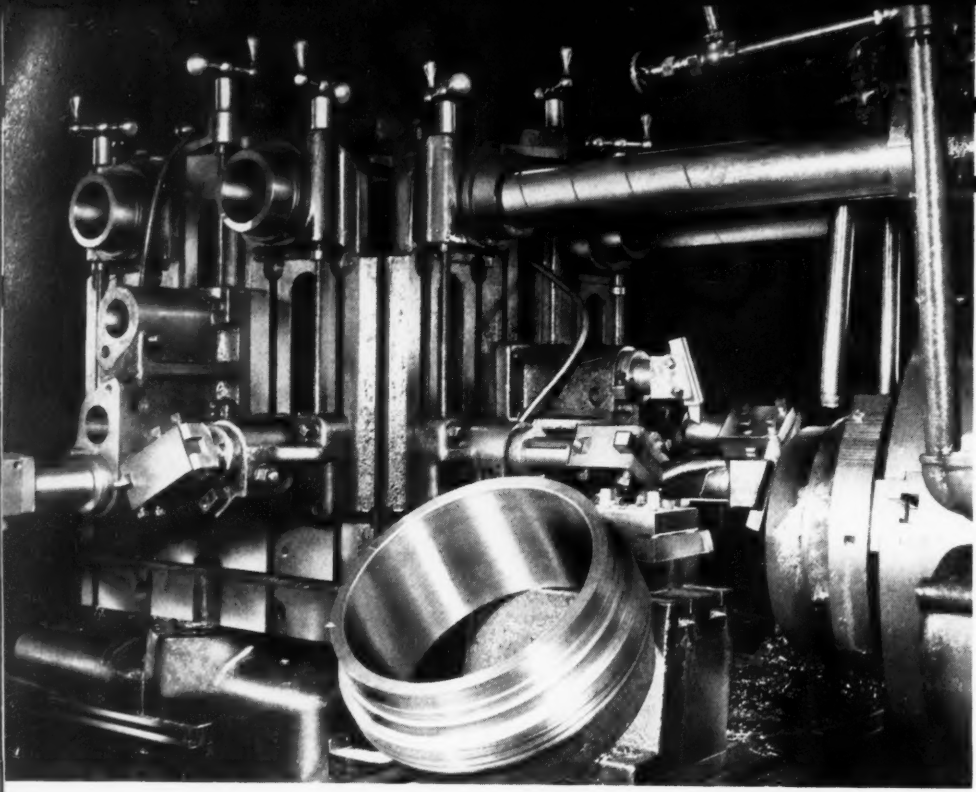


Fig. 3. Tooling Provided on an Automatic Chucking and Turning Machine for Boring and Partially Turning Cones for Locomotive Tapered Roller Bearings

Double cups for roller bearings to be used on passenger cars are machined by the Fastermatics illustrated in Figs. 5 and 6. The first of these illustrations shows the tooling used in boring the cups. In the first step of this operation, the cup end is faced by a tool mounted on the front of the cross-slide. At the same time, the straight bore in the middle of the cup is rough-machined by a tool on the turret.

The turret is then indexed to present a tool to the cup for rough-boring the back taper. This is accomplished by the engagement of a roller on the back of the cross-slide with a cam slot on the bottom of the tool bracket. With this arrangement, the tool is fed sidewise, as well as forward, after it has reached the inner end of the straight bore, so as to cut the back taper. The turret is then indexed to bring another cutter to the work for rough-boring the front taper, this tool also being guided radially by means of the roller on the cross-slide and a cam slot at the bottom of the bracket that carries this tool.

Tools on the three successive sides of the turret are then applied in similar manner for finishing the straight and tapered bores. The last turret face is also equipped with a chamfering tool for the corner of the front tapered surface. A second tool in the front of the cross-slide finish-faces the end of the part during the finishing cut on the straight bore. All cutters are tungsten-carbide tipped. The operation is per-

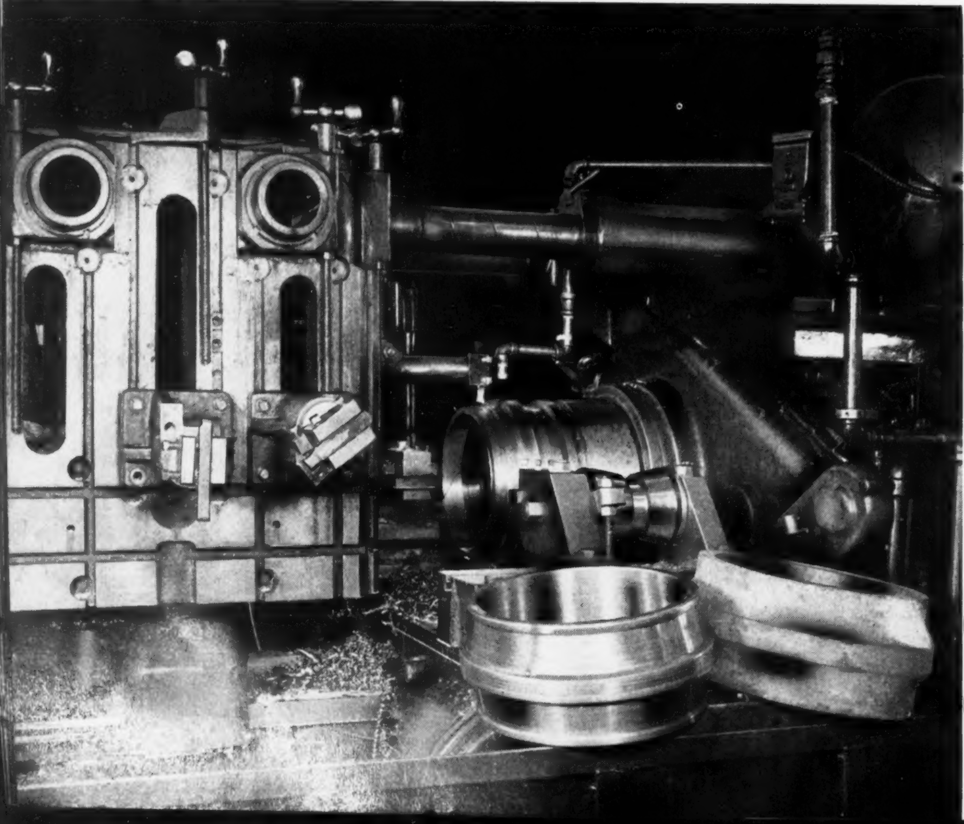


Fig. 4. Circular Form Cutters on the Cross-slide of Another Automatic are Used in Conjunction with Turret Tools for Machining External Surfaces of Locomotive Bearing Cones

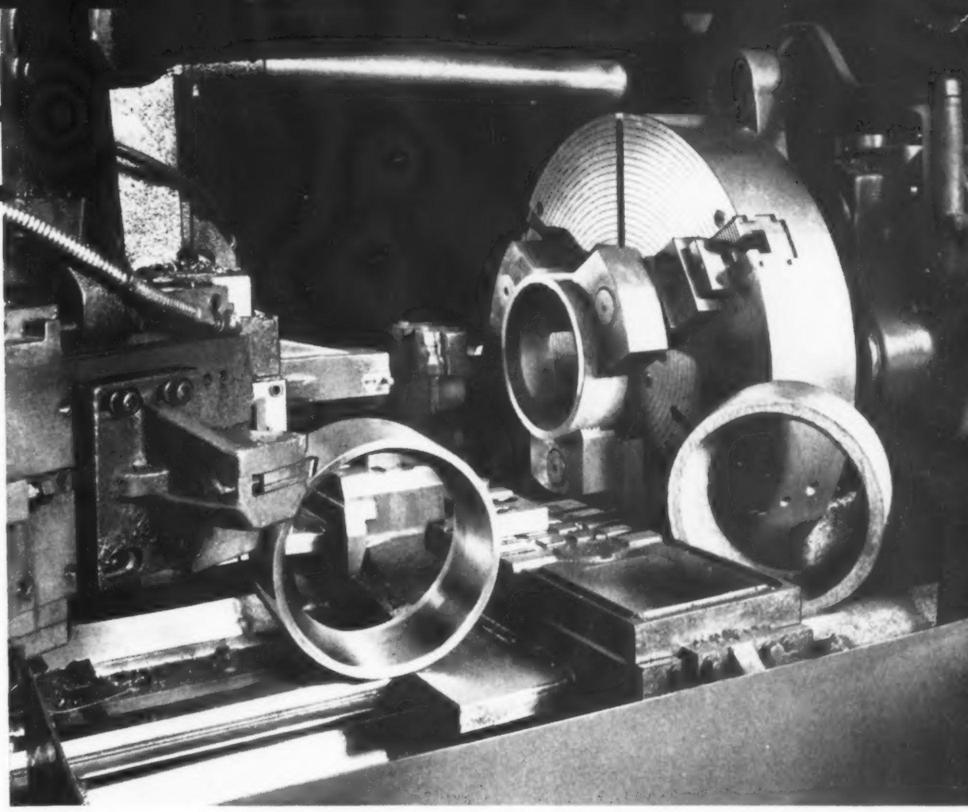


Fig. 5. Boring Two Tapered Seats and a Straight Surface in One Operation Performed on a Fastermatic on the Cups of Bearings for Passenger Cars

★

formed in 13 1/2 minutes, the straight bore being machined to 9.415 inches within plus nothing, minus 0.010 inch. The length of the part is 5.800 inches within plus or minus 0.005 inch. Roughing cuts are taken to a depth of 1/4 inch with a feed of 0.015 inch and a surface speed of 175 feet per minute. The finishing cuts are taken with a feed of 0.020 inch and a surface speed of 250 feet a minute.

The outside of the cups is rough-turned by a tool mounted on the turret of the Fastermatic shown in Fig. 6, and at the same time, the end of the part is rough-faced by a tool on the front of the cross-slide. Then a tool on the second face of the turret finish-turns the part, while another tool on this turret face chamfers the bore. At the same time, two cutters mounted on the rear of the cross-slide round both external corners. These radius tools are made of Stellite, but all others are tungsten-carbide. The finish-turning cutter is automatically raised for the return stroke to avoid scoring the work. Feeds and speeds in this operation are about the same as in the boring operation. The outside diameter of the part is 11.675 to 11.680 inches. The time required for the operation is eleven minutes.

Cups are ground on the ends in the operation shown in Fig. 7, which is performed on a Mattison surface grinder equipped with a Walker magnetic chuck 6 feet long. Five cups 13 inches is outside diameter are being ground at one time to the specified thickness within plus 0.001 inch,

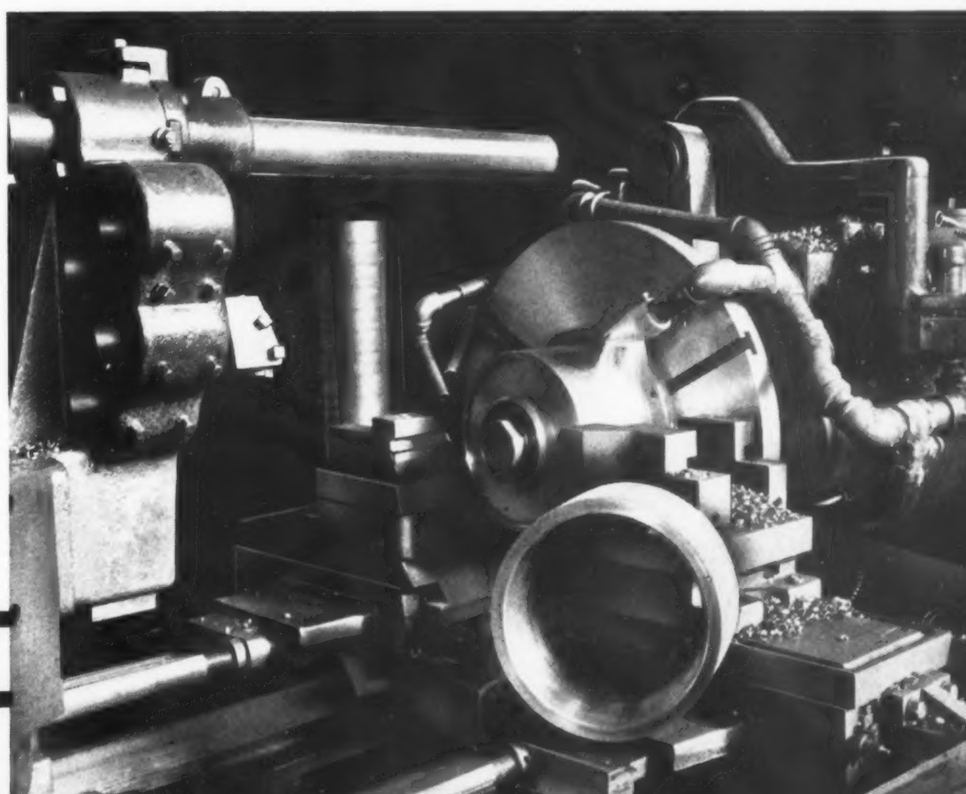


Fig. 6. Another Machine of the Same Type as that Shown in Fig. 5 being Employed for Turning, Facing, and Chamfering the Double Roller-bearing Cups for Passenger Cars

★

Fig. 7. Surface Grinding the Faces of Cups for Railway Bearings, Five at a Time, on a Machine Equipped with a 6-foot Long Magnetic Chuck

minus nothing. A wheel of 6 inches face width is used. The operation is, of course, performed after the cups have been hardened.

In Fig. 8 is shown a Heald internal grinding machine set up for finishing the tapered seat in a single-row cup. The work-head is equipped with a large circular magnetic chuck, on which the cup is accurately seated by bringing an indicator gage in contact with its periphery while the part is revolved. The headstock is positioned at an angle corresponding with the required taper on the inside of the cup, so that the grinding wheel is merely fed forward and backward in a line parallel to the bed of the machine. About 0.015 inch of stock is ground off on a side, and the diameter is held to size within plus 0.001 inch, minus nothing. The chuck is 32 inches in diameter.

The surfaces of the cups and cones on which the tapered rollers ride are honed on special machines of the design shown in Fig. 9 to obtain the high degree of smoothness required. In this operation, the work is rotated at about 2400 R.P.M., with an abrasive stone attached to a ram, as seen at the left, in contact with the tapered surface. This abrasive stone is reciprocated up and down at high speed to hone the full width of the tapered seat. A coolant mixed from International Compound No. 155 and kerosene on a fifty-fifty basis, is supplied in copious quantities to the abrasive stone. The stone is 3/4 by 1 inch in cross-section when new.

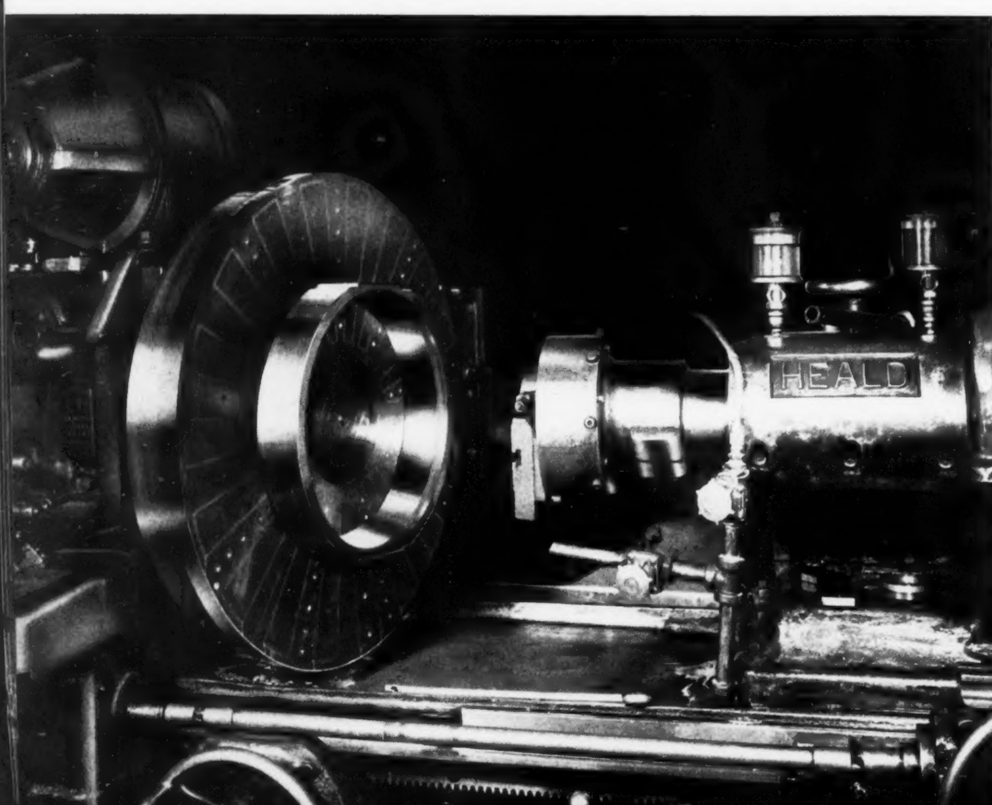


Fig. 8. Grinding Tapered Seat in a Large Railway-bearing Cup on a Machine that Has the Headstock Set at an Angle to Correspond with Required Taper

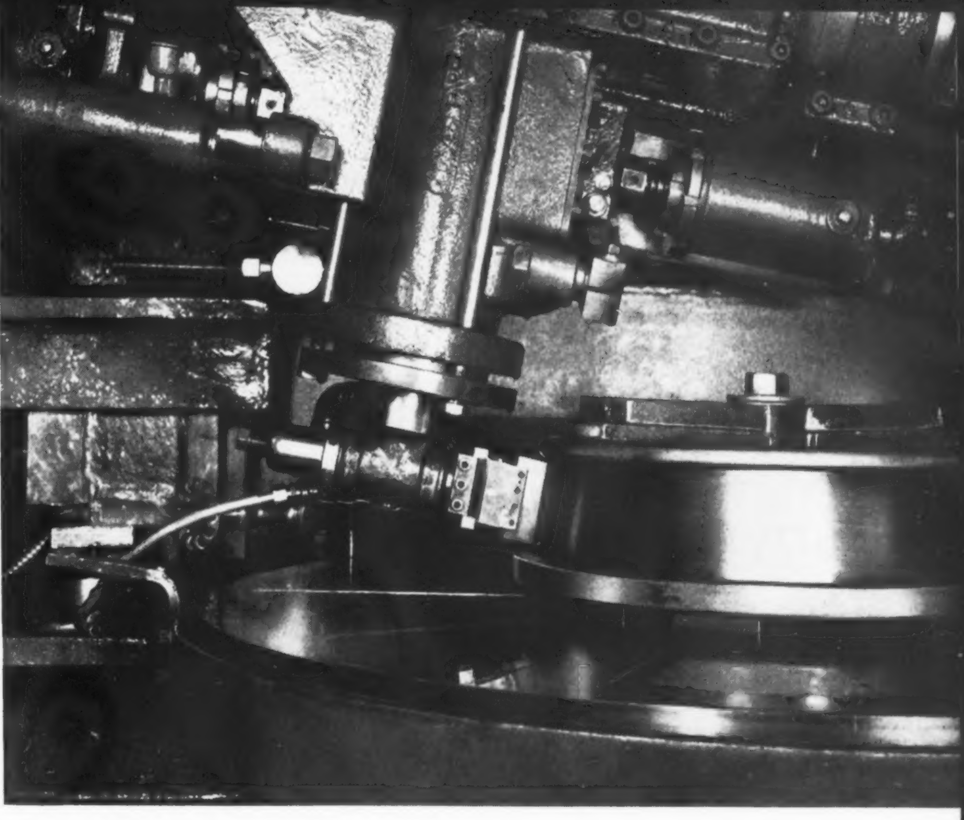


Fig. 9. Honing the Tapered Surface on a Large-diameter Cone by the Fast Reciprocation of an Abrasive Stone through a Short Stroke

★

Stock to a depth of approximately 0.0002 inch is removed in honing, so as to entirely eliminate all grinding fuzz. The grinding head and the cross-rail on which it is mounted are adjustable by air power to suit the individual job. The grinding head can also be swiveled to suit the degree of taper required on the part being honed.

The tapered rollers of small and medium-sized railway bearings are permanently assembled with the cages on the cones by the use of the 100-ton press shown in Fig. 10, which was built by the Hydraulic Press Mfg. Co. Each cage, with the requisite number of rollers, is placed in a die, such as seen at the right of the press table. The die is made with slots in a tapered seat to receive the rollers. After a cage and rollers have been loaded in the die, the cone is slipped into the assembly and the loaded die is pushed under the press ram. When the ram descends and the assembly is forced downward into the die, the webs of the cage between the rollers are pressed inward, and the cage, cone, and rolls are permanently assembled. A pressure of 60 to 70 tons is generally applied to obtain the desired tightness.

The large bearing seen in the die on the press table is a double-row bearing for the main driving axle of a locomotive. The smaller bearings on the bench at the right are intended for application to locomotive tenders.

A second installment of this article will be published in a coming number of MACHINERY.

Fig. 10. Hydraulic Press Used for Assembling the Cages, Cones, and Rollers of Small- and Medium-sized Timken Bearings for Railroad Applications

★

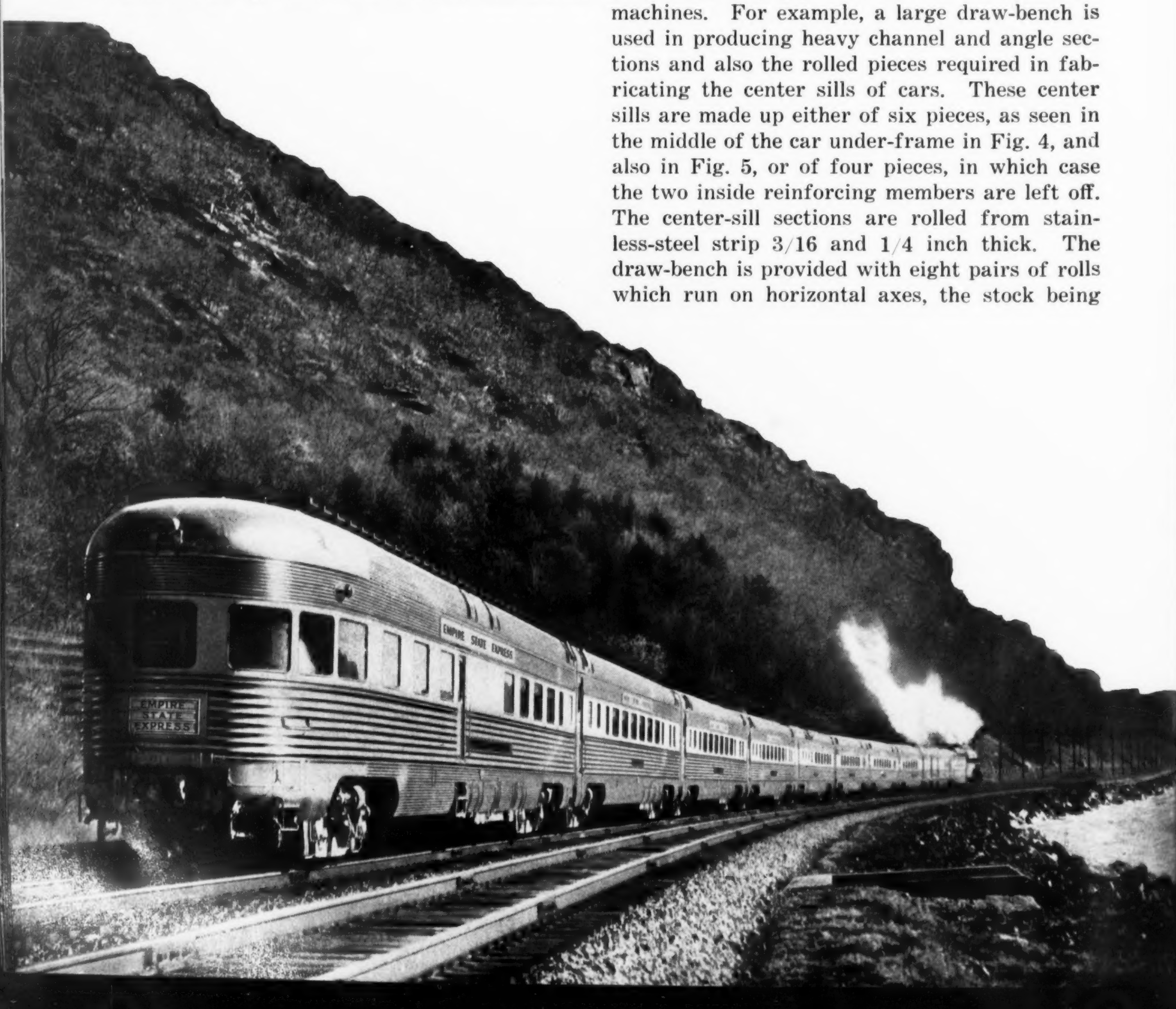
Stainless-Steel Trains for

PASSENGER railroad traffic has increased tremendously since this country started to prepare for war. The roads have been overloaded not only by the necessity of carrying hundreds of thousands of soldiers and sailors between camps and bases, but also by the great increase in travel of civilians engaged in wartime production. Much old railway equipment has been reconditioned and pressed into service to handle the increased traffic, but the conditions demand as many new passenger cars as it will be possible to produce with the materials that are available.

The most notable development in passenger railroad equipment during the last few years is the stainless-steel coaches built by the Edward G. Budd Manufacturing Co. for streamline trains drawn by both Diesel-electric and steam locomotives. As recently as 1934, the first high-speed, lightweight train rolled from the Budd shops; today almost one hundred modern streamline trains ride the rails from coast to coast.

Some of the production methods used in fabricating stainless-steel passenger coaches will be outlined in this article. These cars are built up of structural shapes formed in the Budd plant on draw-benches or brakes and flat plates sheared to the necessary dimensions. The "Shotweld" system is employed in assembling all parts, with the exception of a few members, such as coupler castings, end sills, and draft-gear stops, which are riveted or bolted in place.

Rolling operations on the stainless-steel sheets are performed on draw-benches located adjacent to the assembly jigs and automatic "Shotweld" machines. For example, a large draw-bench is used in producing heavy channel and angle sections and also the rolled pieces required in fabricating the center sills of cars. These center sills are made up either of six pieces, as seen in the middle of the car under-frame in Fig. 4, and also in Fig. 5, or of four pieces, in which case the two inside reinforcing members are left off. The center-sill sections are rolled from stainless-steel strip 3/16 and 1/4 inch thick. The draw-bench is provided with eight pairs of rolls which run on horizontal axes, the stock being



pulled through the machine by a draw-head at one end.

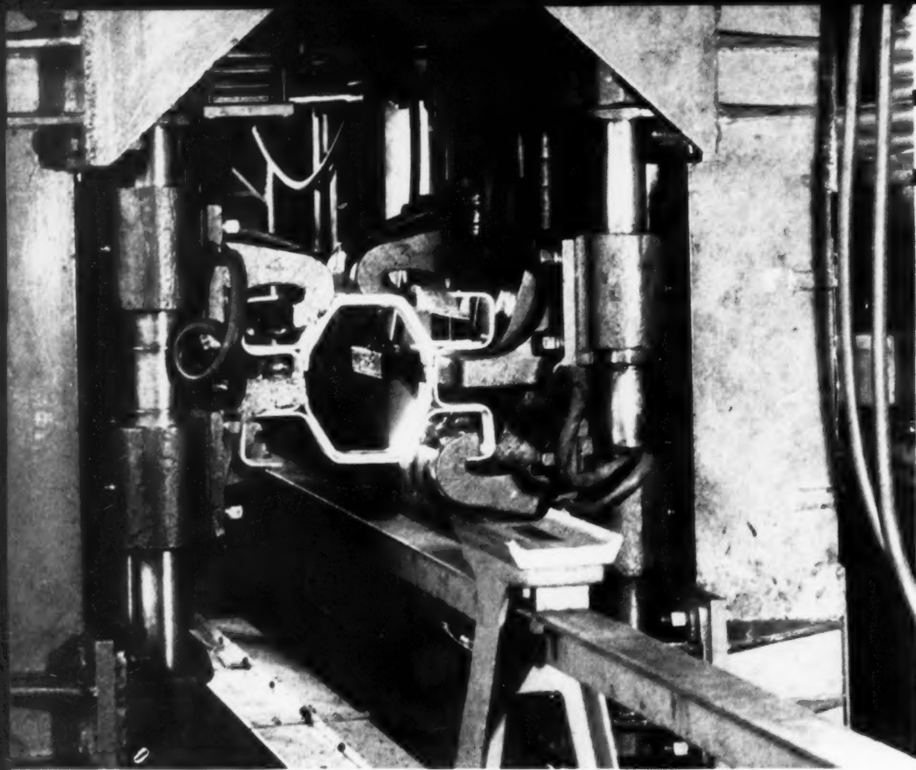
Lighter pieces of stainless steel, such as are used for the corrugated roofs and skirting, for molding, and also for fluted body panels, are rolled by another draw-bench, a close-up view of which is seen in Fig. 2, which handles material up to about 0.075 inch thick. This draw-bench is provided with several pairs of rolls that revolve on vertical axes. In most operations, only four pairs are employed. Roof corrugations are rolled in sections 13 inches wide, which are welded to the roof "carlines." The joints between the roof sheets are made water-tight by soldering.

The center-sill sections are welded into units by the automatic machine shown in Fig. 3. The pieces necessary to make up half of a sill are first clamped in a jig in the proper relation to each other, and then the "Shotweld" machine is traversed along the jig for the entire length of the center sill. At the time that the photograph was taken, narrow strips of material were placed in the machine to indicate the cross-section of the center sill. The machine consists primarily of a carriage on which eight welding guns are mounted. Four of these guns are used on a center-sill half. Two halves are clamped on top of each other in the jig, and the four remaining guns of the "Shotweld" machine are applied in welding them together, to make one complete sill ready for assembly to a car. Individual welding guns of various styles are used in fabricating the cars. Fig. 5 shows a typical gun being employed in final operations on a center sill, and Fig. 1 another type used in assembling a frame member.

The "Shotweld" system, as pointed out in an article published in October, 1935, MACHINERY,

Fig. 1. (Above Right) Using an Individual "Shotweld" Gun in Assembling a Filler Strip to a Post Member of a Stainless-steel Car

Fig. 2. (Right) Rolling a Stainless-steel Section on a Draw-bench that Handles Material up to 0.075 Inch Thick



BUILDING STAINLESS-

Fig. 3. Multiple Type of "Shotweld" Machine which is Equipped with Eight Guns

is essentially spot-welding, so closely controlled as to prevent any harmful change in the metallurgical properties of the metal in or surrounding the weld. The process is based on accurate control of the four principal welding variables, namely, time, current, pressure, and electrode size and shape.

The first two of these variables are controlled electronically, the time of the welding operation being held to as short a period as one-thirtieth of a second with thin material. In welding several sheets of stainless steel 1/8 inch thick, the welding period might be as long as three-tenths of a second. The duration of the welding period is controlled so closely that, even though the temperature at the point of fusion is more than 3000 degrees F., the temperature on the outside surfaces of the stainless steel with which the electrodes are in contact does not exceed 1000 degrees F. The high heat that produces the weld extends only about half the distance from the point of fusion to the outside surfaces of the stainless-steel sheets. The characteristics of stainless steel are therefore retained.

Another important feature of the "Shotweld" system is the provision of an electrical recorder for each welding machine, the function of which is to detect variations in the welding time and current. This recorder is set by the operator while making test welds, the recorder being so adjusted that a pointer deflects half way between limit lines when a weld is being made. If the pointer fails to pass beyond the low-limit line, the length of the welding period will be insufficient to permit satisfactory fusion of the pieces being welded. If, on the other hand, the pointer is swung past the high-limit line, it would indicate that the welding time was too long or the current too high, with the result that the fusion of the pieces being welded might extend to their outside surfaces. If, in the welding operation, the pointer fails to reach the minimum line or passes the maximum line, the timer is automatically "locked out" so that the welding machine cannot be operated, and a bell rings to notify the operator immediately.

In setting the controls for a job, the welder refers to charts that indicate the size of electrode to be used for a given weld, the amount of air pressure to be

Fig. 4. General Assembly Jig, Showing Construction of Center Sill, Bolster Beam, and Floor Beams on Budd Cars

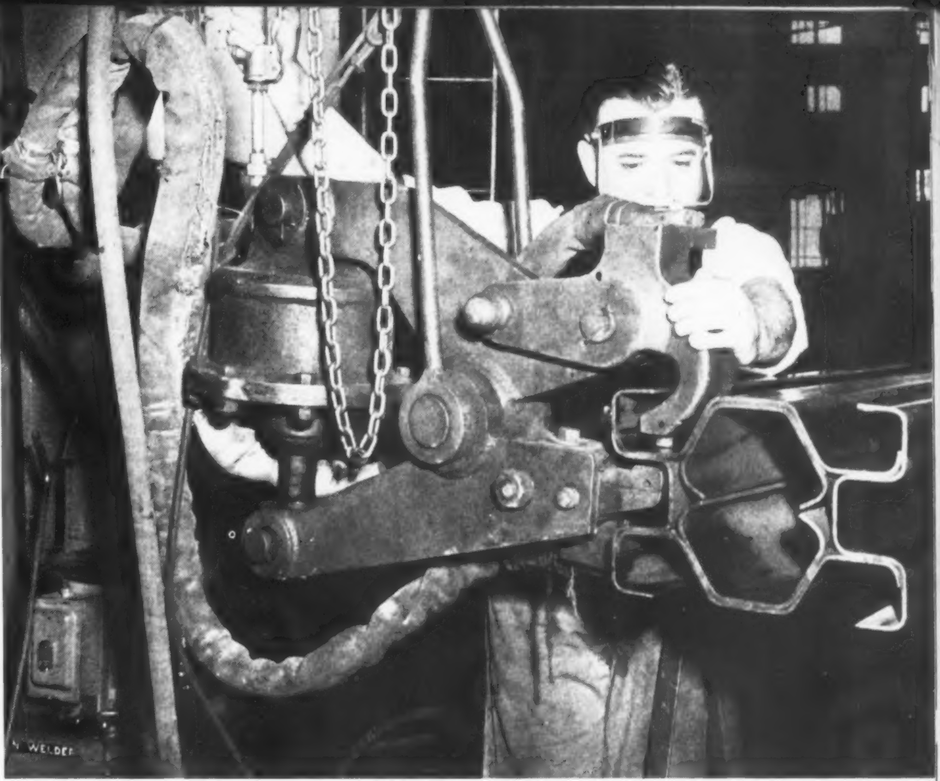


Fig. 5. Individual "Shotweld" Gun Applied in Final Operations on a Center Sill

employed, and the proper welding time in cycles. He sets the current to obtain the desired pull strength on test pieces. These welded pieces are then pulled apart in a testing machine to determine the strength of the welds. If insufficient current is used, the weld strength will be too low, and if too much current is employed, the stainless-steel sheets will be burnt.

The cars are assembled on two duplicate tracks which have four assembly stations each. At the head of each line is a jig for fabricating the roofs. Beside the roof jigs is another jig where the side frames are fabricated. When ready for installation on a car, the side frames are lifted to an overhead storage space at one side of the general assembly jigs, which are second along the assembly tracks.

The view in Fig. 4 shows one of the general assembly jigs. Here the center sill is positioned, and then the under-frame bolsters, floor beams, and stringers are assembled in place. Next two side frames are brought to the jig, then two end frames which have been fabricated on the floor above, and finally an assembled roof. A pit in the floor enables men to work on the under side of the cars. Most of the stainless-steel cars are 85 feet long from coupler to coupler, and the jigs are long enough to handle the largest size.

When the operations in the general assembly jigs are completed, the cars are placed on temporary trucks and rolled to the next position on the tracks. Here brackets and skirts, the fluted section of body panels, and the stainless-steel flooring are assembled. In the next position along either track, the remaining body panels, dead-light panels, and miscellaneous piping are installed. The cars are then sealed temporarily for a water test, which is conducted outside of the building.

From the water test, the cars are returned to the last station of either track, where additional piping is assembled, the air-conditioning units are installed, and under-floor equipment added. They then go to the trim shop, where all wiring is put in, doors hung, glass windows installed, interiors painted, floors finished, trucks applied, furniture installed, and so on. The cars are finally taken to an outside track for cleaning, inspection, and shipment. One stainless-steel car can be built every day in the Budd shop.

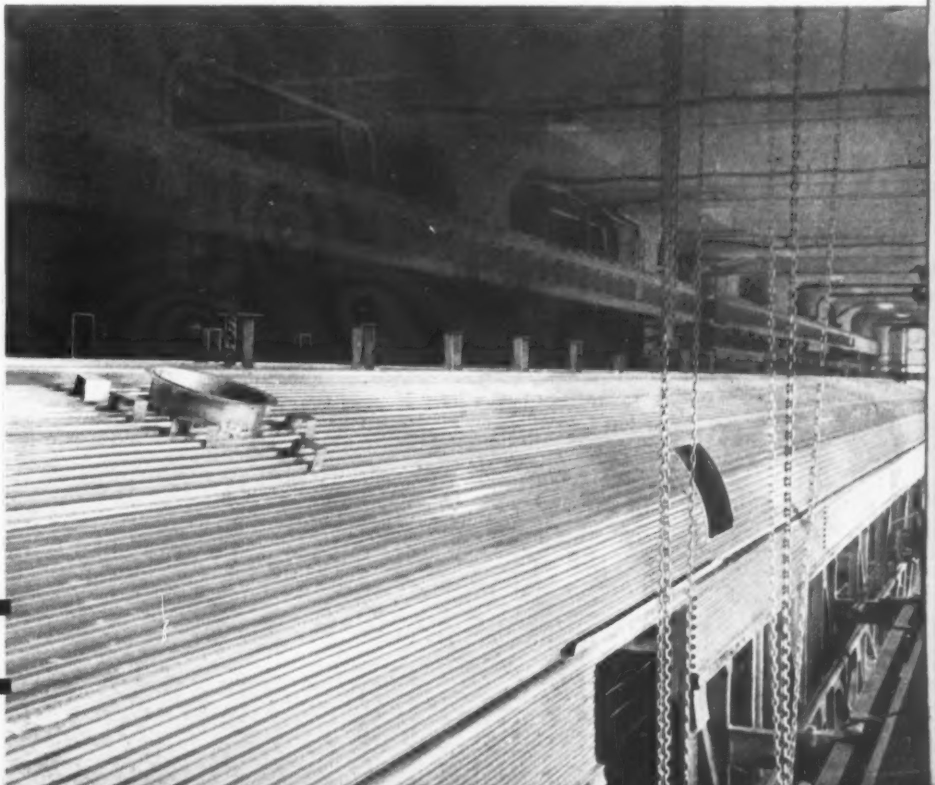


Fig. 6. View of a General Assembly Jig Showing the Floor, Roof, and Side Frame Structure in Place

The B & O Concentrates

By W. S. EYERLY, Superintendent of Mount Clare Shops

FOUR heavy repair shops and a considerable number of roundhouses and smaller outlying repair shops are operated by the Baltimore & Ohio Railroad System along its more than 6000 miles of track. They serve approximately 2200 locomotives. In years gone by, repair parts were machined from the rough in all the repair shops and even at some of the roundhouses. Large inventories of repair parts were necessarily spread all over the system, and maintenance costs were high, as locomotive parts had to be machined in each shop on a limited quantity basis.

Several years ago, the officials of this railroad decided to concentrate the production of all repair parts at the Mount Clare shops in Baltimore. There parts are finished, except for the final fitting that may be necessary in order to adapt them to worn mating parts on the locomotive to which they are actually assembled. Thus, for example, it is necessary for the outlying shop to bore crown bearings to the actual size of the journals to which they are to be fitted. However, the work of the repair shops has been reduced on the average job to one or two hours instead of the five to ten hours required in the past.

With this centralization of production, inventories have been greatly reduced, and it is necessary to control stock at one plant only. There are no longer large stores of raw materials and parts in process at other repair shops and roundhouses. This system has also made it practicable to adopt quantity production methods in many instances. Machine tools have been so located in the Mount Clare shops that the various locomotive parts are completely finished by machines arranged in groups, eliminating the trucking of parts between operations almost entirely. The finished parts are shipped on skids to the various points along the line where needed.

Typical operations in this shop will be described in the following. Fig. 1 shows a Gray planer machining sixteen cross-heads at one

Production in One Shop ★

time. The operation consists of planing the fit for the cross-head shoes, the edges of the flanges, the outside surfaces of the flanges and the wrist-pin bosses. Both sides of the cross-heads are finished on this machine, the work being turned over after being planed on one side. Two tool-heads on the cross-rail and two side-heads are employed. About 1/4 inch of stock is removed in the roughing cuts on these steel castings, and 1/64 inch in the finishing cuts. The planer is operated at a cutting stroke of 40 feet a minute and at a return stroke of 75 feet a minute. The setting up of the cross-heads is facilitated by the use of a parallel block that extends the full length of the table in the middle.

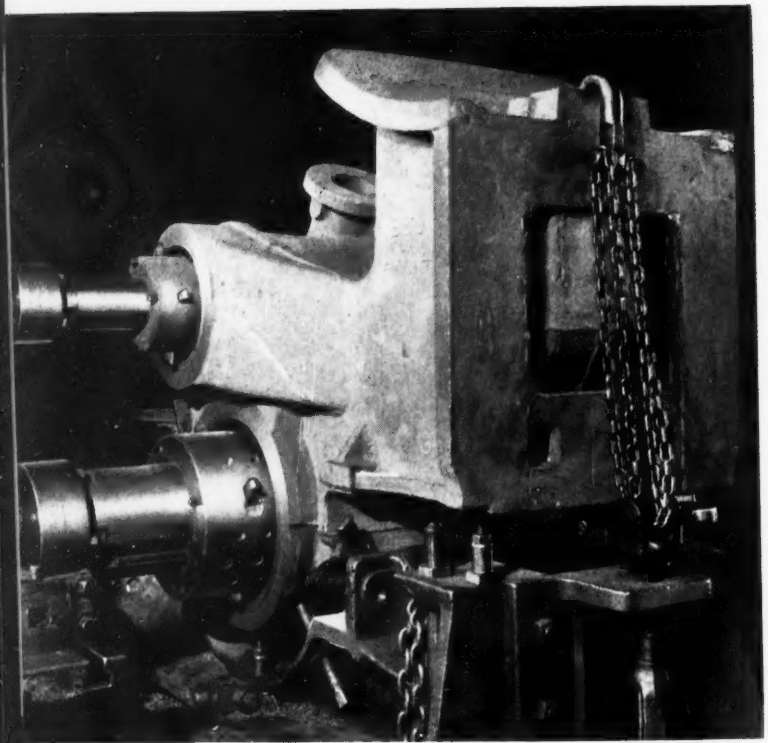
A somewhat more unusual operation, also performed on this machine, consists of planing the shoe fit on vibrating type driving-boxes. For this operation, guide bars such as seen in the background of Fig. 1 at the right are mounted along the middle of the table, and an attachment with two rollers is connected to the under side of the two cross-rail heads. These rollers run in the tracks of the guide bars and impart sidewise movements to the tool-heads as the table moves back and forth beneath them, the tool-heads being disconnected from the lead-screw ordinarily used to feed them across the rail.

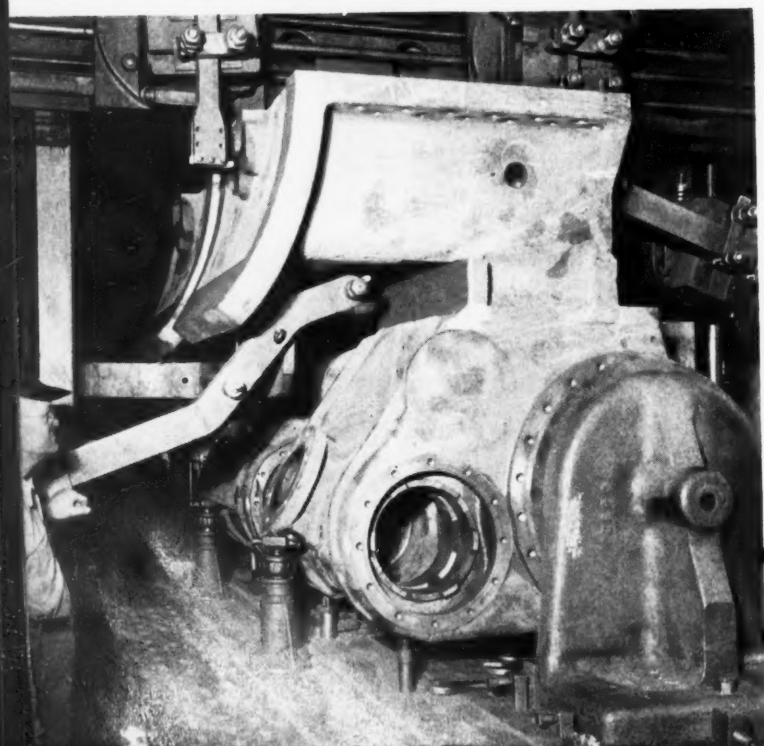
The cam-like surfaces of the box guide are such that the shoe fits are planed to a taper at each end and to a 3-inch long straight surface in the middle. The guide bars are long enough to enable sixteen driving-boxes to be machined at one time, arranged in two rows on the planer.

Main driving-boxes are rough- and finish-machined on their outside faces and rough-machined on their inside faces on the planer illustrated in Fig. 2. About 1/4 inch of stock is planed off in roughing, and 1/8 inch in finishing. Screw jacks are used between the boxes to keep them from shifting, and also at both ends of the table. Fourteen driving-boxes are mounted on the table at one time.

Cylinders are bored simultaneously in the piston and valve chambers by the two-bar boring mill illustrated in Fig. 3, which is equipped with heavy tool-bars extending from headstocks at the left to outboard supports on the right-hand end of the work-table. Two tool-heads are fed along these bars by lead-screws in slots extending the length of the bars. Four or five

Fig. 1. Planing Sixteen Locomotive Cross-heads at One Time in a Shop where the B & O Produces Locomotive Parts for All of Its Repair Shops and Roundhouses





cutters are used on the heads in roughing and two in finishing.

The large bar that carries the tool-head used in boring the piston chamber is 12 inches in diameter, and the head mounted on it is 18 1/2 inches in diameter. The smaller bar has a diameter of 6 inches, and its tool-head is 11 1/4 inches in diameter. When cylinder chambers are larger than can be accommodated by tool-heads of these diameters, blocks such as seen lying in front of the headstock that drives the large boring-bar, are mounted on the boring heads to increase their cutting diameter.

One work-holding fixture suffices for all sizes of cylinder castings machined in this shop. The headstock that drives the smaller boring-bar can be adjusted up and down on a column, which can also be adjusted transversely. The headstock of the large boring-bar can be adjusted transversely only. In unloading a finished cylinder casting, the table that carries the work fixture is fed toward the right until the casting has been completely withdrawn beyond the ends of the boring-bars, the outboard supports, of course, moving with the table.

In planing cylinder castings, unusual tooling is required because of the necessity of reaching almost inaccessible surfaces. This operation is performed by a large planer shown in Figs. 4 and 5 set up for the simultaneous machining of two cylinder castings. In the first of these illustrations is seen a long tool-holder attached to the side-head on the left-hand housing of the machine. The tool-holder is further supported by a brace that is bolted to the inside of the column. It is held against this brace by a helical coil spring. This tool is used to plane two frame fit surfaces. The practice is to first plane the horizontal surface from the outside to the corner, and then plane the vertical surface from

Fig. 2. (Top) Another Quantity-production Operation in which Driving-boxes are being Planed for B & O Locomotives

Fig. 3. (Center) The Piston and Valve Chambers of Cylinder Castings are Bored Simultaneously in a Two-bar Boring Mill

Fig. 4. (Bottom) Planing Operation on Cylinder Castings in which a Long Tool-bar Machines the Frame Fit on One Side

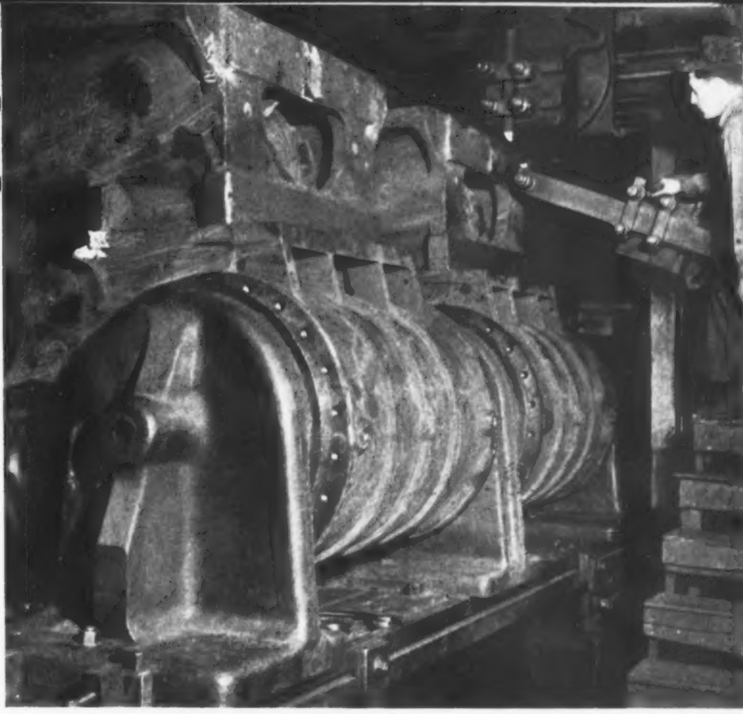
the bottom end to the corner. The left-hand cross-rail head planes the exhaust pads.

While these cuts are being taken, the right-hand cross-rail head is applied as shown in Fig. 5 for planing across the top of the castings, as seen on the machine, which is the surface that is bolted to another cylinder casting when the part is mounted on a locomotive. The right-hand side-head is used for planing the two surfaces of the frame fit on this side of the casting.

Accuracy of set-up is obtained in this operation through the use of fixtures that locate the castings from the finish-bored piston chambers. Each end of the chamber is seated on a large-diameter cone which enters the piston chamber a distance of 4 or 5 inches. With the cylinders thus located, the planer operator can readily apply screw jacks, as seen in Fig. 4, to lift the valve chamber the required distance above the planer table so as to insure dimensional accuracy in planing the fits. The saddle of cylinder castings is planed on a machine equipped for feeding a tool at the required radius.

Two main-rods are being slab-milled at one time in the operation shown in Fig. 6, which is performed on a Niles planer type milling machine. There are two sets of six interlocking cutters each, which are 10 inches in diameter by 4 inches in width. These cutters are of helical type, those in one group being of right-hand style and those in the other, left-hand style, so as to equalize the cutting strains. Both roughing and finishing cuts are taken on the crank-pin blocks at the ends of the rods, after which roughing cuts are taken on the body and extensions as shown. Channels are later milled in the body, and are finally ground, "radiused," beveled to prevent fracture, and polished.

An Ingersoll vertical milling machine is applied as shown in Fig. 7 for milling around the



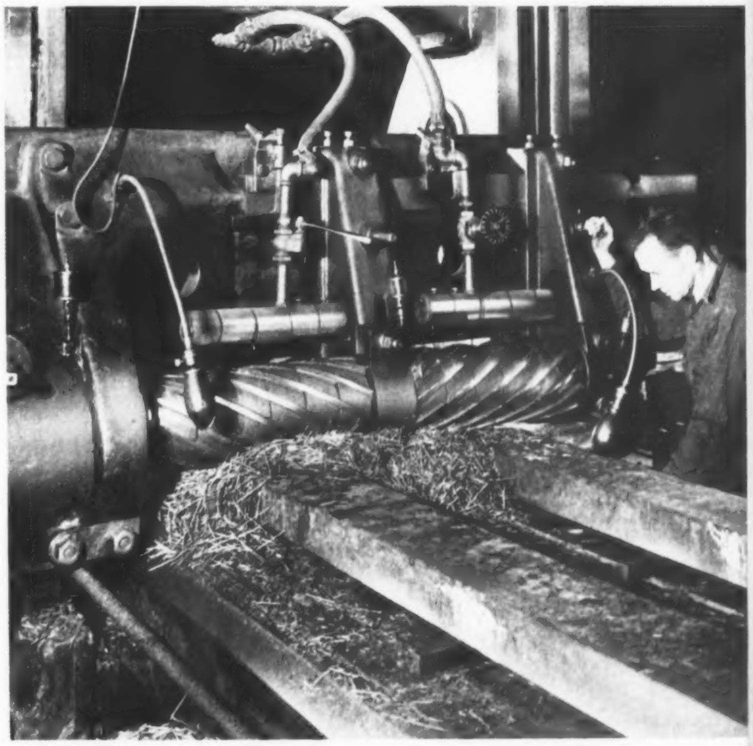


Fig. 5. (Top) Opposite Side of the Machine in Fig. 4, Showing the Fixtures that Insure Accurate Set-up of the Cylinder Castings

Fig. 6. (Center) Milling Two Main-rods on a Planer Type Milling Machine with Helical Cutters of Right- and Left-hand Types

Fig. 7. (Bottom) Milling a Circular Collar or Boss around One End of a Locomotive Main-rod on a Vertical Milling Machine

integral collars or bosses on the ends of main- and side-rods. The required fillet is obtained around the collars through the use of a form milling cutter. The operator merely feeds the main-rod into the cutter until the required depth of cut is obtained, and then engages the feed of the circular table to cause the rod to turn slowly about the center of the end being milled. After it has been milled half way around, the longitudinal and circular tables are adjusted to bring the opposite side of the rod in proper relation to the cutter for milling.

Gray-iron cylinder bushings or liners up to 45 inches long and 42 inches in diameter can be turned and bored on the Bullard vertical turret lathe shown in Fig. 8, which was built with an extra high column for this purpose. Another feature of this machine is a special feed for the tool-head used in boring. It would not be possible to feed a tool-bar mounted on the turret in the conventional manner, the distance necessary for machining the liner. Use is therefore made of a head that is fed up and down along a stationary arm of hexagonal cross-section which is attached to one of the turret stations. The tool-head is fed up and down through a feed-screw which is driven through short shafts and universal joints from the regular side-head feed. Two cutters are used on the boring head. They are mounted on slides which can be fed radially outward by turning a wrench handle applied to a square-end shaft on the special attachment, as seen in the illustration. In this manner, the tools can be set for cutting to the desired depth and also fed outward for machining a counterbore in each end of the casting and for cutting off to the required length, in one set-up of the work. The counterbores are usually about 6 inches long.

Fig. 8. Boring and Turning a Large Cylinder Liner on a Machine Provided with an Extra High Column and Special Boring Equipment

The particular cylinder liner shown on the machine in Fig. 8 was finished to an outside diameter of 25 1/2 inches and an inside diameter of 24 inches, the casting being 43 inches high when faced to length. Stock is cut to a depth of 1/2 inch on a side in rough-turning the external surface, and simultaneously to a depth of 3/8 inch in rough-boring. The outside of the liners is turned to two slightly different diameters, the liner being turned to the cylinder size for one-half its length and to a pressed fit for the remainder of its length. The inside of the liner receives a final cut by means of a portable boring unit after it has actually been fitted into a cylinder so as to eliminate inaccuracies resulting from distortion during assembly.

One of the cylinder liners is completely turned, bored, faced at the top, and cut off at the bottom on the Bullard vertical turret lathe within eight hours, whereas by the methods formerly used, eighteen to twenty-two hours were consumed in taking these cuts on two machines.

All cutting tools used in this shop are sharpened in a centralized grinding department by men assigned especially to that work. The tools required by each machine tool operator are delivered to him twice a day by a messenger from the tool grinding department who, at the same time, collects all dull tools. If an operator experiences any difficulty with a cutter, he turns on an electric switch adjacent to his machine, which causes a light to go on in the centralized tool grinding department. A man is sent at once from that department to remedy the condition.

All work going through this shop is kept on skids when not actually in a machine. This keeps the shop aisles unusually neat, guards against damage to work, and facilitates the transportation of work from machine to machine.

Make Use of the Experience and Skill of Older Men to Speed War Work

By GEORGE T. TRUNDLE, JR., President
Trundle Engineering Co., Cleveland, Ohio

WE have in this country thousands of older men—men over sixty, who have the skill and the experience and judgment that come only with years. Among them are retired plant managers, engineers, superintendents. Among them, also, are thousands of men who have been foremen or supervisors. But how many of these men are at work today, helping us speed our war production program?

Long since, we said that they were too old. Many of them have left industry or are tucked away in odd corners. Some are living quietly on their savings. You will find many of them doing jobs that make no use of their years of shop training. We must put these men to work in industry. We need their help.

If a man knows how to run a plant or how to design and lay out equipment, what difference does it make whether he is over sixty or over seventy? The fact is that his age is simply a measure of his experience — and we certainly need experience today. One of our troubles is that we have too few engineers, too few plant managers and superintendents, with a background broad enough to enable them to devise, adapt, substitute, or exercise ingenuity in the use of machines and materials.

The older men, over the years, have faced problems of this sort before. They have lived through many phases of the development of production facilities, and have a range of experience that younger men cannot possess. The idea that men are too old for shop work is a hold-over from the days when shop work involved hard physical labor. It seldom does today.

Nowadays machines do most of the work. Men supply the intelligence. Besides, we don't need older men to run machines. With operations broken down and simplified, we can train new, younger men, fairly easily, to run machines.

What we need are the supervisors to teach the younger, newer men how to run machines. And we can't train new supervisors fast enough. That's where the older men can step right into the picture today. Bring the older men back into the plant and have them teach the youngsters.

Older men have seasoned judgment and the skill that only age can bring. They are not going to get a "case of nerves" under pressure. Remember, they have been through one war production emergency. Their "know how" is not confined to the most modern method. They know many different ways of getting the job done. They know how it was done in 1916, and in 1906, and in 1896. This knowledge is vital today.

We are embarking, today, upon a drive to utilize all existing manufacturing facilities for our supreme war production effort. Of necessity, this means using many old machines—in some cases, machines thirty or forty years old. Many of the youngsters of today do not know how to get production out of these old machines. But the old-timers know how.

Furthermore, they know something that few of the youngsters know today—they know how to do accurate work on old machines that were not designed to function to today's standards of accuracy. They know how to use these old machines just as an expert wood-carver wields a knife, or an expert violinist plays a violin; because, in years gone by, accuracy had to be obtained by craftsmanship rather than from the mechanical perfection of the machine itself.

In many of the country's smaller shops today, you will find an old-timer, an expert mechanic, who is the guiding genius of that shop. Most of the equipment may be obsolete. Some of the methods employed might seem, by modern standards, hopelessly old-fashioned. And yet that shop can turn out first-class work, to modern standards, and in a volume that is surprising.

And above all, there is the all-important factor of time. We desperately need additional shop management and supervisory forces; and the time is past when we can hire them from each other. We can develop them by selecting men from the plant floor and up-grading them—but this means training courses, and training courses take time. Furthermore, training courses alone will seldom turn out a finished plant manager or superintendent. That takes experience.

But if we can locate the "old-timers" and bring them in, they can take hold of shop management and supervisory jobs in a matter of days or weeks. And because of their age, their experience and their judgment, they will command respect. They may be too old to join the "shootin'" Army, but they are not too old to help fight this war. Give them a chance to be lieutenants in the battle of production!

EDITORIAL COMMENT

War Output Demands Salvaging of Scrap Metal and Chips

The war will make many materials scarce—industry, as well as individuals, has already found that out. Continued supplies of materials can best be assured by reducing waste and by careful salvage of all scrap metals. One of the secrets of successful reclamation is the identification and segregation of different reclaimed materials; and the sorting of scrap must start at the source—that is, in the shop where the chips and scrap are produced.

According to *Nickel Steel Topics*, the experience of a large steel producer is indicative of what can be done. In this plant, over one hundred carloads of iron and steel scrap had accumulated which had a value, when reclaimed and sold, of over $50,000. More important, however, from the point of view of the national war economy is the point that this scrap permitted the production of four times the tonnage of the salvaged material in open-hearth ingots. In this instance alone, over 10,000 tons of steel were made available for war production through the salvaging of iron and steel scrap.

Inspectors Should Use Specifications with Judgment

Every possible means for speeding up deliveries of war material is obviously of the utmost importance. In some instances, the delivery of material that is perfectly satisfactory for the purpose for which it is intended has been held up by the rigid requirements of government inspectors. It is said that a great deal of valuable material and much labor are sometimes wasted by scrapping parts that the inspectors do not pass, although, in ordinary industrial operations, the material would be salvaged and serve the purpose as well as if it were perfect.

One example that has been mentioned is that of cast gear guards with small pin-holes in the castings. Instead of throwing these guards away, the pin-holes could readily be filled before the surfaces are painted and the guards would fulfill their purpose just as well as if the castings had been flawless. It is one thing to have small defects in the wearing surface of a slide, and quite another thing to have the same minute defects in a gear-guard casting.

Attention has also been called to practices in the inspection of welded products. In one instance, it is said that the inspector made a Magnaflux examination of a weld after every few passes of the electrode. The inspector also had the option of calling for as many as 35 X-ray inspections on gun mounts. Yet this welding work is done by a manufacturer with a reputation for quality work.

It is conceded that the job of finding competent inspectors to handle the thousand and one items that the Government now must purchase is a difficult one. It is also difficult to say how much the inspector should leave to the judgment and discretion of the manufacturer; but the fact remains that war production could be accelerated by more experienced inspectors, capable of using their own judgment in matters where nothing of real consequence is involved.

Motion Pictures an Excellent Means of Shop Training

At this time, when rapid training in the first principles of machine tool operation is of such supreme importance, the motion picture film is demonstrating its value as an adjunct to training courses. Films once produced can be distributed at comparatively small cost to hundreds of schools and shops for training young men in the operation of machines and in the use of tools. With the motion picture, parts of a film can be repeated as many times as desired; and slow motion can be employed to show clearly and in detail what is being done.

A large number of firms and educational institutions have produced motion pictures for training purposes. It is certain that the motion picture will play an increasingly important part in the training of mechanical workers.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Rapid-Motion, Short-Stroke Wire-Feeding Mechanism

By L. KASPER

The mechanism here illustrated is designed for feeding a strand of wire rapidly through a wire fabricating machine in a series of short strokes, with equal rest periods between strokes. Owing to the high speed of the machine, it was necessary that the mechanism provide a reciprocating movement with a minimum of vibration, and that a positive gripping arrangement be used for feeding the wire.

Referring to Fig. 1, the shaft *B* rotates in the stationary part of the machine *A*, in the direction indicated by the arrow, and carries the gear *C* that is keyed to it. The slide *F* is carried in the part *A*, and is slotted, as shown, to clear the hub of gear *C*. Slide *F* carries two studs on which the elliptical gears *D* and *E* revolve freely, receiving their motion from the gear *C*. In this view, the teeth on the shorter side of the major axis of gear *D* are in mesh with the teeth of gear *C*, while the teeth on the longer side of the major axis of gear *E* mesh with the teeth on the opposite side of gear *C*. In this position, the center-to-center distance between the axes of gears *C* and *E* is greater than that between gears *C* and *D*. As the studs that carry the gears *D* and *E* are fixed in slide *F*, the latter is thrown off center, to the right, with relation to shaft *B*, the slide *F* being at its extreme right-hand position. The bar *H* carries the gripper mechanism *G*, which feeds the wire *W*, as will be explained later.

In Fig. 3, gear *C* has made a partial revolution, resulting in a half revolution of gears *D* and *E* and reversing the condition shown

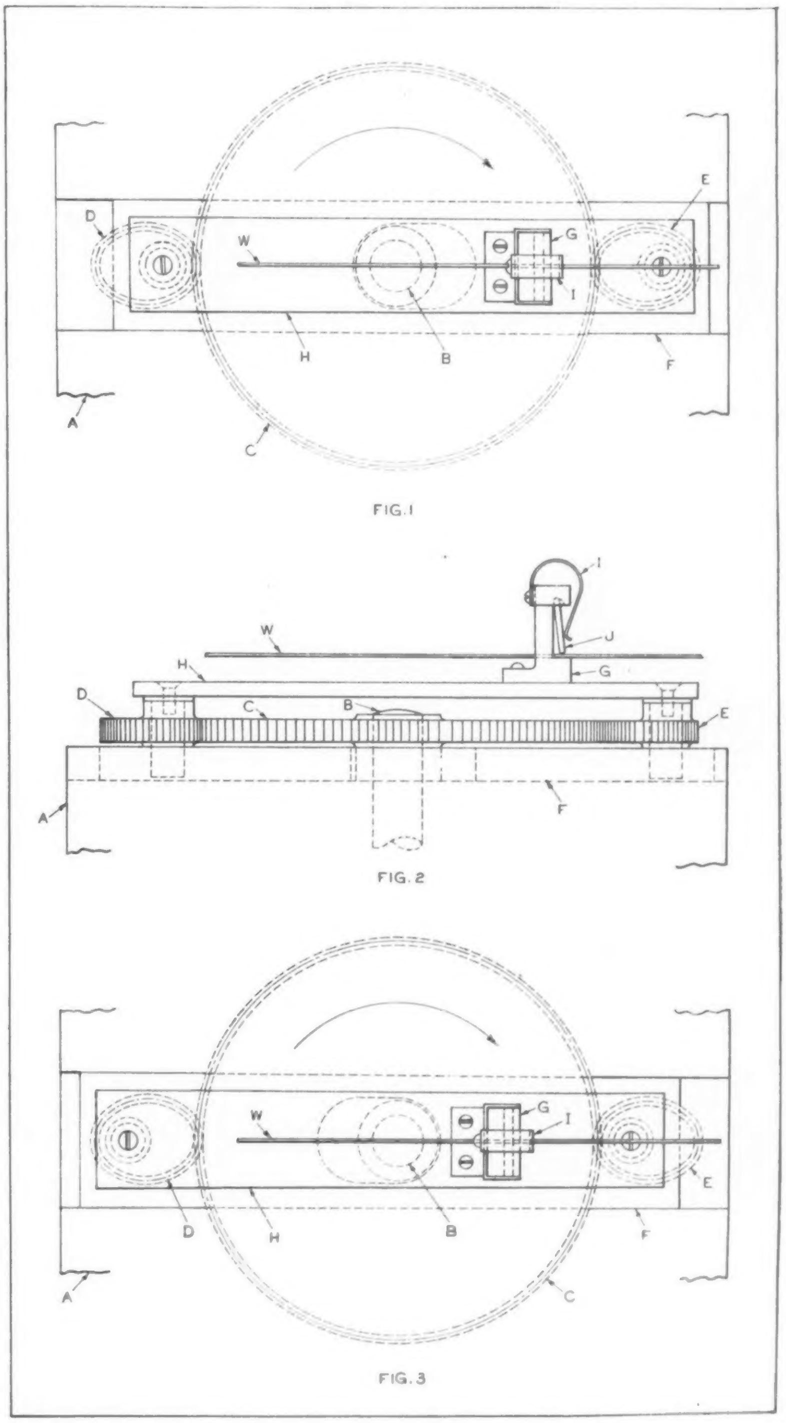


Fig. 1. Wire-feeding Mechanism Designed for Rapid, Short-stroke Motion. Fig. 2. End View of Mechanism Shown in Fig. 1, in which Slide F is at End of Feeding Movement to Right. Fig. 3. Wire-feeding Mechanism with Slide F at End of Return Stroke

in Fig. 1; at this point the slide *F* has been moved to its extreme left-hand position, the distance traveled by the slide being equal to the eccentricity of gears *D* and *E*.

The details of the gripper mechanism are shown in Fig. 2, which is an end view of Fig. 1. The bar *H* is carried on the studs that carry gears *D* and *E*, and therefore moves with slide *F*. The wire *W* passes through the part *G*, which is mounted on bar *H*. The wire *W* rests on the ledge of part *G*, against which it is held by the wedging action of plate *J*, the flat spring *I* acting on plate *J* to insure a positive wedging action. As the bar *H* moves to the right, the plate *J* wedges between its seat in part *G* and the wire *W*, gripping the latter firmly, and feeding it into the machine. As the bar *H* moves to the left, the wedging action is destroyed and plate *J* slides over the wire *W*, without transmitting any motion.

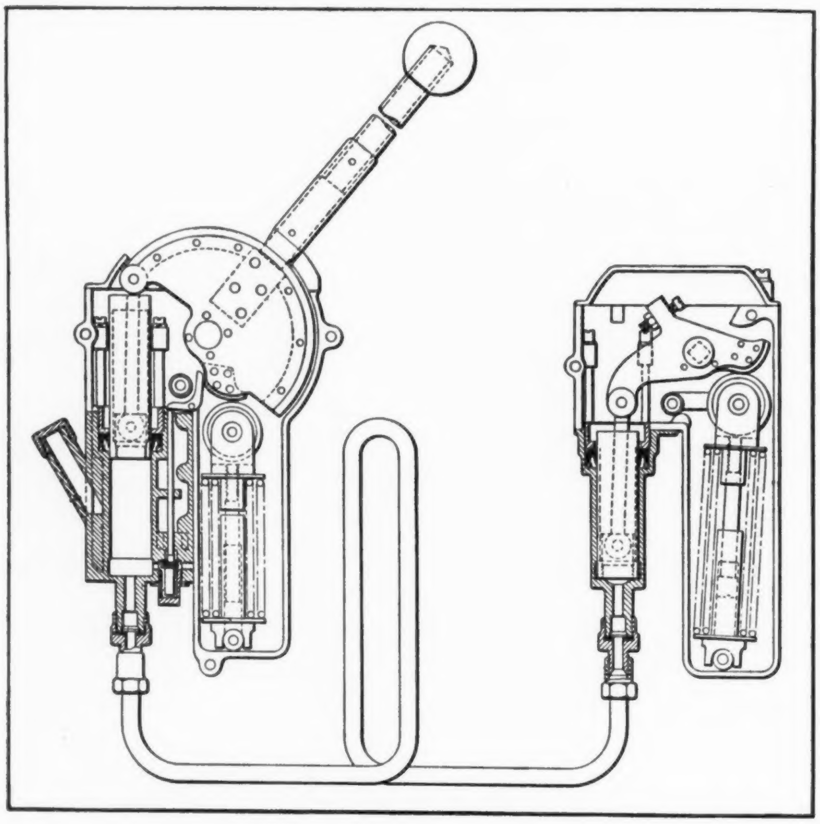
Hydraulic Remote Control

A hydraulic remote control, which can be employed for the operation of machine tools and is being used to an increasing extent for aircraft, where it provides a simple and effective means of operating throttle and mixture controls, landing lamps, two-speed blowers, oil coolers, hot and cold air intakes, and slow-running cut-outs, has been developed by the Exactor Control Co., Ltd., Alperton, Middlesex, England.

This control is also employed in connection with the power units of rail cars, marine craft, and stationary installations where complete accuracy of control is essential or in cases where difficult installation problems are encountered. A special application is employed for the control of constant-speed air screws, while the use of duplex receiver units affords the possibility of controlling two units from the same transmitter lever, as, for example, in the case of twin-engined aircraft.

The standard control is capable of transmitting a torque of 130 inch-pounds on the suction stroke, but on the pressure stroke a much higher torque can be obtained. The standard unit is set to operate through an angle of 60 degrees. The combined weight of the transmitter and receiver is 4 3/4 pounds, to which is added the weight of the single length of piping required.

The control comprises a transmitter unit and a receiver unit, connected by a length of piping. The transmitter unit (shown to the left in the accompanying illustration) is provided with a hand-lever, while the receiver unit (shown at the right) has a lever that accurately duplicates the motion of the transmitter lever without backlash. The only connection between the two units is one small-size pipe, which can be bent around intervening members or obstructions.



Hydraulic Remote Control Consisting of Transmitting and Receiving Units Connected by Pipe

A ball-ended hand-lever is mounted on the shaft of the transmitter, and the corresponding shaft of the receiver is connected by a crank-arm and link to the lever for which remote control is desired. The cylinders of the transmitter and receiver are each fitted with a trunk type piston, fluid tightness being insured by the use of a special packing gland. The cylinders and connecting pipe are completely filled with a non-freezing fluid; and since both cylinders are of the same diameter, a downward movement of one piston must result in a similar upward movement of the other.

Each piston is connected by rod and radial crank-arm to the shaft, so that, in the transmitter, the rotary shaft movement is converted into longitudinal piston movement and a conversion in reverse to this is

obtained in the receiver. Opposing springs acting on the two pistons keep the fluid system under pressure; and as this pressure causes a certain amount of friction in the special packings, the system is made virtually self-locking.

It is clear that if the pressure applied to the fluid by the springs is not to result in movement of the pistons, it must be exactly balanced at all parts of the stroke, and this is effected in the following manner: Two concentric helical springs are mounted on a guide, pivoted at its lower end and carrying at its upper end a roller which is connected to a rocking lever. A crank-arm, keyed on the shaft, is extended to form a cam of varying radius, and this bears on the surface of the roller. The design is such that the spring pressure applied to the piston acts through a short radius when the spring is compressed, and through a longer radius when the spring is extended. In this manner, variations in spring pressure are compensated for, and the load on the pistons due to this pressure is constant.

It may be noted that the lower end of the transmitter cylinder communicates with a reservoir through a spring-loaded valve. In normal operation, this valve is closed; but when the operating lever is moved to the end of its stroke, the final 4 degrees operates the valve mechanism and opens the valve against the action of a spring. The system is then open to the reservoir and the pressure is instantly released. Thus, variations in volume due to temperature change or possible leakage are compensated for automatically, any deficiency being made up from the reservoir and any excess being expelled by the receiver piston, which, on release of the pressure, is forced to the bottom of its stroke under spring action. The initial backward movement of the transmitter allows the valve to close, and any further movement of the operating lever is reproduced by an equal movement of the receiver lever.

Similarly, the release of the pressure in the system as a result of a pipe-line fracture causes the receiver piston to be forced back to the end of its stroke under spring action, which insures that any failure will result in the control moving to a predetermined position. B. M.

* * *

Cutting Oil for Machine Gun Barrel Rifling

A rifling oil of unusually light body which meets the demands of hydraulically operated rifling machines has been developed by E. F. Houghton & Co., Philadelphia, Pa. This oil is known as "Cut-Max Rifling Oil." It flows freely through small orifices, and is said to have given very satisfactory performance under high production conditions.

Motion Pictures Aid War Production Work

In a recent article by Lieutenant Colonel Roy L. Bowlin in *Army Ordnance*, on "Motion Pictures as an Aid to Quantity Manufacture in Shell Production," attention is called to the value of motion pictures in training men for war work. The article tells the story of how the General Railway Signal Co., Rochester, N. Y., combined sound and color motion pictures with verbal instructions for recording methods used on an Army Ordnance educational order.

The article points out that this motion picture may enable other manufacturers to save weeks, possibly months, by the study of the accepted procedure. It will help them to determine whether they have available machines and other facilities for handling similar work. They can also learn from the picture what floor space may be required, observe the methods of handling shells and of scrap disposal, as well, of course, as the economical sequence of operation and machining methods.

The picture gives operating time for every operation, from actual performance. The figures thus established, although in many instances they may be excelled in quantity manufacturing, are a valuable guide in planning production.

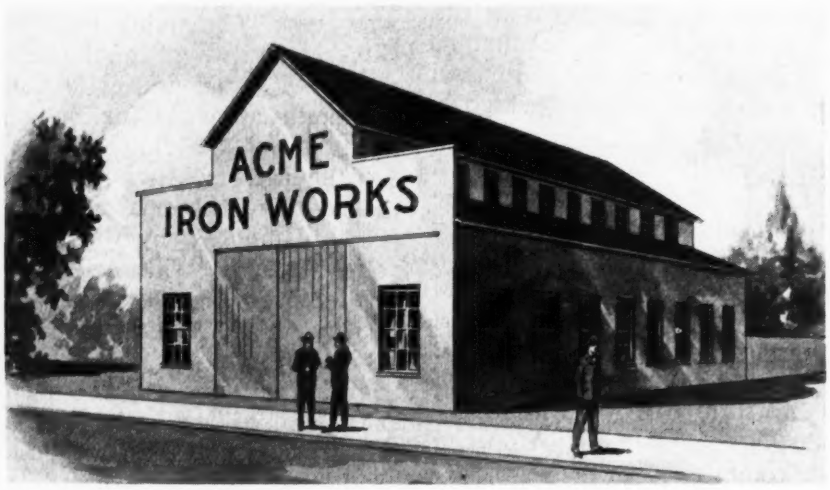
"It appears certain," Lieutenant Colonel Bowlin states, "that the picture represents a valuable service and short-cut not previously applied to ordnance manufacture. In this field, at least, it exemplifies a new means of communication. It is, consequently, an interesting question whether any ordnance process involving combined machine work and manual dexterity does not require such audio-visual clarification for maximum efficiency."

* * *

Induction Heating Makes it Possible to Braze 10,000 Pieces a Day

By means of "thermonic" induction heating equipment, manufactured by the Induction Heating Corporation, 389 Lafayette St., New York City, 4-pound units used in filling a Government order are being brazed at the rate of 10,000 a day. The heating is applied by a push-button control, and a continuous flow of parts makes possible the large production rate mentioned. Skilled labor is not necessary for the operation of this equipment, and after the preliminary set-up, no adjustments need be made. The operation is automatic, and there are no rejections, because every unit is heated and handled in exactly the same manner. The cost is said to be one-tenth of a cent per brazing operation, based on a current cost of two cents per kilowatt-hour.

A Typical American Free Enterprise Celebrates Its Fiftieth Anniversary

★  ★

The Small Machine Shop in Santa Ana, Calif., where the Axelson Brothers Started in Business Fifty Years Ago

MORE than fifty years ago, C. F. Axelson, who was employed as a machinist in Topeka, Kan., and his brother, G. A. Axelson, an experienced molder, had visions of running a machine shop of their own. However, the starting of a machine shop in Topeka did not seem to offer many opportunities for the progressive young men. Some other location where industrial development was just beginning and the population rapidly increasing seemed to be the better choice.

In the early part of 1892, the two brothers learned of a small shop that was for sale in Santa Ana, Calif. This appeared to them to be a good location; and in the spring of that year, C. F. Axelson journeyed to California and acquired the shop for himself and his brother, the entire purchase price being $1200. They called their new shop the Acme Iron Works.

They completed their original plans in a small way by adding an iron foundry, and so the Acme Iron Works became a new venture in the history of American industry—typical of America—with three employes in the machine shop and two in the foundry. The horsepower was as limited as the man power; and whenever iron was being poured in the foundry, the machine shop had to close down.

For the first two years, the business was devoted to repair work of all kinds. Then, about 1894, the Axelsons began to experiment with a small internal-combustion engine to be attached to a bicycle. It worked, and became the prototype of the modern motorcycle. In 1895, they decided to experiment with an automobile engine and to go into the automobile business; but the Acme Iron Works in Santa Ana was entirely inadequate for an automobile factory. It was, therefore, sold and a new shop acquired in Los Angeles. This shop was 30 by 50 feet. In 1897, a four-cylinder in-line automotive engine was actually designed and built. It might have been successful, except for the lack of suitable ignition.

The courage and versatility of the brothers were such that they tackled almost any mechanical problem. In 1898, a concern wanted them to build a large printing press for printing orange tissue wrappers. C. F. Axelson designed and built what is believed to be the first machine of its kind west of the Mississippi. It printed tissue paper in three colors, and made use of an air blast, thereby anticipating the modern devices using suction in feeding presses. Two weeks after this machine had been completed and set up, it was turning out tissue-paper orange wrappers at the rate of 125,000 an hour.

It was in the latter part of 1898 that the opportunity came for the company to engage in the business that has since been its principal line of endeavor. A very heavy gravity oil carrying a high percentage of sand was being produced in the Bakersfield territory. Ordinary pumps could not handle the oil efficiently on account of its weight, and the valves wore out rapidly by the abrasion of the sand.

At that time, the Axelsons were approached by a Mr. Parker from Bakersfield who brought with him the design of a patented pump suitable to overcome the difficulties in pumping heavy-gravity oil containing sand. Arrangements were made for the manufacture of these pumps on a contract basis. Soon the company began also to manufacture non-patented pumps, and from that time on, it has held a prominent position in oil-field equipment.

In 1900, it became necessary to acquire a new shop covering 175 by 150 feet. Later, additions were made to this shop, and by 1917, the business had for the fourth time outgrown its manufacturing capacity. At that time, a main shop, constructed of brick, with a floor space of over 50,000 square feet was erected. Six other buildings were added, including a foundry of brick and corrugated iron. These buildings aggregated a floor space of 33,200 square feet.

In June, 1919, the business was incorporated under the name of the Axelson Machine Co.; in 1930, the name was changed to Axelson Mfg. Co. Today, in addition to the Los Angeles plant, the company also owns and operates a plant in St. Louis, Mo.

Entrance to the Office Building of the Axelson Mfg. Co.'s Los Angeles Plant as it Appears Today

The company is also known as a builder of machine tools. During the last World War, it began to build heavy-duty lathes—now an important part of the company's products. These lathes are manufactured in from 14- to 32-inch sizes. In addition, the company has engaged in precision gage making. The gage business originated from the company's own needs for gages in the manufacture of interchangeable pump parts, but is now a commercial business of considerable proportions.

In reviewing the fifty-year span of the Axelson Mfg. Co., the special important contributions to industry by this company may be listed as follows: Development and improvement of the metal-to-metal pump principle, increasing pump efficiency and life; introduction of an improved sucker rod, overcoming costly breaks in the well; inauguration of interchangeable pump parts, permitting rapid repairs at the well; and the setting of standards of accuracy for the oil-well supply industry. This is an achievement worthy of note on the fiftieth anniversary.

Accounting for Special Reserves Arising Out of the War

The Committee on Accounting Procedure of the American Institute of Accountants has published a research bulletin on the subject "Accounting for Special Reserves Arising Out of the War." This bulletin is concerned primarily with the treatment of reserves in the financial statements of manufacturing and other business organizations who are "substantially engaged, directly or indirectly, in production for war purposes, or are materially affected by conditions growing out of the war."

The bulletin covers a list of eleven purposes for which special reserves may be provided. Since these reserves are important, not only to individual business enterprises, but to the national economy as a whole, the subject is one of interest to every industrial business executive. Copies can be obtained by responsible business executives, treasurers, and controllers of industrial corporations from the American Institute of Accountants, 13 E. 41st St., New York.

* * *

Advertising will gain in value to the advertiser through his own increased understanding of its potential usefulness to him. By making more of a personal contribution to his advertising, he can increase its worth.

Tenth Annual Meeting of Tool Engineers

THE tenth annual convention of the American Society of Tool Engineers was held at the Hotel Jefferson, St. Louis, Mo., March 26 to 28. Representatives of all the chapters of the Society, now numbering more than fifty and representing a total membership of over 10,000, met at this time to discuss methods for accelerating the nation's war production and for conserving the supply of materials and tools. The various sessions were presided over by the president of the organization, F. W. Curtis, of the Van Norman Machine Tool Co., Springfield, Mass.

Frank W. Curtis, President of the American Society of Tool Engineers

The topic of the opening session Thursday, March 26, was "Conversion from Peace to War Production." Clifford Ives, state director of contract distribution of the War Production Board at Milwaukee, presented the Government aspect of the problem, and Hugh H. C. Weed, vice-president of the Carter Carburetor Corporation, St. Louis, outlined the industrial viewpoint.

At the session Thursday evening, the subject of "Substitutions and Shortages of Materials" was discussed. Arthur Stockstrom, president of the American Stove Co., spoke on the general problems of the non-defense industries. Dr. D. R. Kellogg, of the Westinghouse Electric & Mfg. Co., covered engineering, manufacturing, and metallurgical problems that are involved in the substitution of materials.

The subject of "Cutting Tool Conservation" was dealt with at the Friday morning session, March 27, when A. H. d'Arcambal, vice-president, sales manager and consulting metallurgist of the Pratt & Whitney Division, Niles-Bement-Pond Co., spoke on "Getting the Greatest Service out of Cutting Tools." L. W. Lang, sales manager of the National Tool Salvage Co., spoke on the salvaging of worn-out cutting tools, usually thrown on the scrap heap. Professor O. W. Boston, of the University of Michigan, also presented a paper before this session on "Tool Life and Cutting Fluids."

Colonel R. E. Hardy, of the St. Louis Ordnance District Office, dealt with "Problems Relating to Defense Inspection" at the Friday afternoon session. F. E. Allison, chief inspector of the Wagner Electric Corporation, spoke at the same session on industry's inspection problems in connection with war work.

Saturday morning there was a session devoted to aircraft mass production. At this session, H. E. Linsley, of the Wright Aeronautical Corporation, spoke on "Manufacture of Aircraft Engines." Colonel Kenneth B. Wolfe, of the Production Engineering Section, Materiel Division, U. S. Army Air Corps, Curtiss-Wright Field, Dayton, Ohio, spoke on "Problems of the Service as They Influence Design, Procurement, and Production."

Spring Meeting of Mechanical Engineers in Houston, Texas

THE American Society of Mechanical Engineers held its national spring meeting in Houston, Tex., March 23 to 25, with headquarters at the Rice Hotel. The keynote of the meeting was "Engineering Production for Victory." Prominent ordnance officers of the War Department were present, and spoke on subjects of great importance at the present time. Brigadier General Earl McFarland was the principal speaker at a dinner held on the evening of March 24, and Lieutenant Colonel D. J. Martin spoke at one of the sessions of the meeting on the manufacture of large guns.

During the meeting there were sessions on fuels, petroleum, textile engineering, marine power, corrosion, war production, training of labor, aviation, small-plant management, heat-recovery equipment, and flash-freezing of foods. The next national meeting of the Society will be held in Cleveland, Ohio, on June 8 to 10.

LOADS AND DEFLECTIONS OF STAINLESS-STEEL ROUND-WIRE HELICAL SPRINGS—1

Diameter of Wire, Inches. Upper Figure, Maximum Safe Load P, in Pounds; Lower Figure, Deflection y, in Inches per Coil

Outside Diameter of Spring, Inches	0.015	0.0162	0.0173	0.0181	0.0204	0.0230	0.0258	0.0286	0.032	0.035
1/8	0.452	0.565	0.685	0.784	1.10	1.55	2.14	2.88	3.89	4.89
	0.00901	0.00804	0.00728	0.00680	0.00555	0.00445	0.00359	0.00293	0.00228	0.00181
5/32	0.370	0.459	0.557	0.638	0.898	1.28	1.78	2.40	3.28	4.22
	0.0155	0.0139	0.0128	0.0119	0.00989	0.00824	0.00678	0.00568	0.00456	0.00382
3/16	0.311	0.388	0.471	0.538	0.761	1.08	1.51	2.05	2.82	3.66
	0.0238	0.0213	0.0198	0.0186	0.0156	0.0131	0.0109	0.00935	0.00767	0.00658
1/4	0.233	0.292	0.354	0.407	0.580	0.831	1.16	1.57	2.18	2.84
	0.0456	0.0412	0.0380	0.0361	0.0309	0.0263	0.0224	0.0194	0.0165	0.0144
5/16	0.187	0.237	0.286	0.326	0.467	0.669	0.936	1.28	1.76	2.31
	0.0742	0.0674	0.0628	0.0592	0.0512	0.0442	0.0380	0.0333	0.0283	0.0251
3/8	0.156	0.196	0.239	0.275	0.391	0.555	0.732	1.06	1.48	1.94
	0.110	0.100	0.0930	0.0885	0.0768	0.0659	0.0572	0.0504	0.0434	0.0387
7/16	0.134	0.169	0.204	0.236	0.336	0.480	0.676	0.918	1.29	1.68
	0.152	0.140	0.129	0.123	0.107	0.0930	0.0810	0.0716	0.0623	0.0556
1/2	.....	.....	0.180	0.208	0.295	0.421	0.592	0.808	1.12	1.47
	.....	.....	0.172	0.164	0.143	0.124	0.108	0.0964	0.0838	0.0748
5/8	.....	.....	.....	.....	.....	0.340	0.478	0.648	0.908	1.19
	.....	.....	.....	.....	.....	0.202	0.177	0.156	0.137	0.124
3/4						.....	.....	0.546	0.765	0.990
						.....	.....	0.233	0.205	0.184
7/8						.....	.....	.....	0.652	0.851
						.....	.....	.....	0.283	0.256
1						.....	.....	.....	.....	0.748
						.....	.....	.....	.....	0.341

All values in this table are based on 45,000 pounds per square inch fiber stress. The values given are for severe service. For average and light service, multiply these values by 1.25 and 1.55, respectively.

The tables in these Data Sheets, Nos. 463 and 464, and in Nos. 465, 466, and 467 to follow, give the maximum safe load P, in pounds, and the deflection y, in inches per coil, for round stainless-steel wire (18-8) springs in Steel Wire Gage sizes. These tables eliminate the need of using formulas on a trial basis for a wide range of sizes; at least, they enable the designer to select quickly a spring diameter and wire size that approximate his requirements. When a wire size or spring diameter not covered in this tabulation is needed, the final calculations are made by using the following formulas.

For maximum safe load P in pounds

$$P = \frac{\pi d^3 S}{8DK_1}$$

For the deflection y in inches per coil

$$y = \frac{\pi S D^2}{G d K_1} \text{ in which}$$

S = safe fiber stress, pounds per square inch;
G = modulus of elasticity in torsion (pounds per square inch) = 10,500,000 for stainless steel;
d = wire diameter, inches;
D = mean diameter of spring = outside diameter minus wire diameter;
K_1 = Wahl factor =

$$\frac{4C-1}{4C-4} + \frac{0.615}{C} \quad \text{where } C = \frac{D}{d}$$

Wahl factor values will be given in Data Sheet No. 467 to be published in June, 1942.

MACHINERY'S Data Sheet No. 463, April, 1942

Compiled by J. I. Hommel
Westinghouse Electric & Mfg. Co.

LOADS AND DEFLECTIONS OF STAINLESS-STEEL ROUND-WIRE HELICAL SPRINGS—2

Diameter of Wire, Inches. Upper Figure, Maximum Safe Load P, in Pounds; Lower Figure, Deflection y, in Inches per Coil

Outside Diameter of Spring, Inches	0.038	0.040	0.041	0.048	0.050	0.054	0.059	0.063	0.072	0.080
1/8	6.06	6.73	7.18	....	....	....	....	....	....	....
	0.00146	0.00123	0.00115	....	....	....	....	....	....	....
5/32	5.25	6.04	6.45	9.68	10.5	....	....	....	....	....
	0.00313	0.00283	0.00266	0.00176	0.00154	....	....	....	....	....
3/16	4.60	5.34	5.62	8.78	9.67	11.8	14.7	....	....	....
	0.00562	0.00508	0.00476	0.00340	0.00307	0.00253	0.00197	....	....	....
1/4	3.60	4.17	4.46	7.04	7.88	9.72	12.5	15.0	21.0	....
	0.0125	0.0115	0.0110	0.00830	0.00769	0.00656	0.00545	0.00471	0.00336	....
5/16	2.92	3.40	3.64	5.77	6.49	8.16	10.4	12.6	18.3	24.3
	0.0221	0.0205	0.0197	0.0154	0.0143	0.0126	0.0107	0.00944	0.00720	0.00568
3/8	2.48	2.87	3.09	4.90	5.50	6.93	8.92	10.8	15.8	21.2
	0.0347	0.0327	0.0311	0.0247	0.0230	0.0206	0.0175	0.0158	0.0125	0.0102
7/16	2.13	2.50	2.70	4.25	4.78	5.98	7.75	9.38	13.8	18.8
	0.0497	0.0467	0.0452	0.0361	0.0340	0.0304	0.0265	0.0238	0.0192	0.0160
1/2	1.89	2.18	2.36	3.76	4.23	5.28	6.87	8.32	12.3	16.6
	0.0682	0.0634	0.0614	0.0499	0.0470	0.0420	0.0371	0.0336	0.0275	0.0230
5/8	1.50	1.76	1.90	3.03	3.43	4.31	5.58	6.76	10.0	13.6
	0.111	0.105	0.102	0.0839	0.0795	0.0721	0.0642	0.0581	0.0481	0.0410
3/4	1.28	1.47	1.59	2.54	2.86	3.60	4.68	5.68	8.46	11.6
	0.163	0.157	0.153	0.126	0.120	0.109	0.0969	0.0896	0.0747	0.0646
7/8	1.10	1.28	1.36	2.19	2.46	3.08	4.04	4.88	7.27	10.0
	0.234	0.221	0.213	0.176	0.169	0.153	0.138	0.127	0.107	0.0928
1	0.952	1.11	1.20	1.92	2.18	2.74	3.54	4.30	6.40	8.78
	0.311	0.293	0.285	0.238	0.227	0.207	0.186	0.171	0.145	0.127
1 1/8	0.855	0.990	1.07	1.70	1.92	2.43	3.16	3.84	5.69	7.80
	0.399	0.377	0.367	0.305	0.292	0.268	0.241	0.223	0.188	0.166
1 1/4	.....	.....	0.966	1.54	1.74	2.18	2.85	3.46	5.16	7.03
	.....	.....	0.459	0.384	0.365	0.335	0.303	0.281	0.239	0.210
1 3/8	.....	.....	.....	1.41	1.58	1.99	2.60	3.16	4.68	6.42
	.....	.....	.....	0.470	0.448	0.411	0.379	0.344	0.294	0.259
1 1/2	.....	.....	.....	.....	1.45	1.83	2.38	2.90	4.31	5.90
	.....	.....	.....	.....	0.540	0.497	0.448	0.415	0.356	0.314
1 5/8	.....	.....	.....	.....	.....	1.69	2.20	2.68	3.97	5.47
	.....	.....	.....	.....	.....	0.588	0.531	0.493	0.421	0.375
1 3/4						.....	.....	2.49	3.71	5.06
						.....	.....	0.577	0.497	0.441
1 7/8						.....	.....	.....	3.46	4.76
						.....	.....	.....	0.576	0.511
2						.....	.....	.....	3.25	4.45
						.....	.....	.....	0.660	0.589

All values in this table are based on 45,000 pounds per square inch fiber stress. The values given are for severe service. For average and light service, multiply these values by 1.25 and 1.55, respectively.

For maximum safe load and deflection formulas, see Data Sheet No. 463.

MACHINERY'S Data Sheet No. 464, April, 1942

Compiled by J. I. Hommel
Westinghouse Electric & Mfg. Co.

What the Product Designer Should Know About Plastics

Characteristics and Application of Plastics, and Directions for the Design of Plastic Molded Parts for Economical Quantity Production — Second of Five Articles

By ERIK FURHOLMEN, Chief Estimating Engineer
Chicago Molded Products Corporation

THERE are two general types of molding plastics which are separate and distinct in that the one is *thermosetting* and the other *thermoplastic*. The former undergoes a chemical change when molded, and, as a result, the change is permanent—that is, the plastic cannot again be softened sufficiently to reshape it. It also becomes insoluble. The temperature at which it is molded is usually considerably higher than with thermoplastic materials, and the finished product is capable of withstanding temperatures in some cases up to 350 degrees F., or higher, without injury.

Thermoplastic materials, though hard and relatively rigid at ordinary temperatures, begin to soften at as low a temperature as 140 degrees F. The material undergoes no chemical change when molded, and subsequent heating somewhat beyond its softening point returns it to its plastic state. Except for these two fundamental differences, many of the properties of the two types of plastics are quite similar.

Types and Characteristics of Molding Plastics

Nearly all plastics come in various grades or types each suited for one or more applications. Phenolic plastics, for example, come in such types as "general purpose," "heat-resistant," "low (electrical) loss," "impact-resistant," and "chemically resistant." In such cases, the resin and filler content are varied and the properties differ accordingly. The same is, in general, true of other plastics.

When an article is being designed for production, it is essential that the designer know approximately the characteristics of the material he intends to use. If a molding plastic is chosen, it is well to know also the kind of mold and method of molding most suitable. The following information is intended to help in selecting the proper plastic. It covers the molding materials that are most commonly used at the present time. The most outstanding characteristics of each are given. The plastics are arranged in alphabetical order for ready reference.

Acrylic resins, which go by the trade names of Acryloid, Crystalite, Lucite, and Plexiglas, have a clear resin base, are thermoplastic, and can be molded either by compression or by injection. They are available in a wide range of colors. Crystal clearness is their outstanding feature. Other properties include excellent stability, high resistance to moisture and to weather conditions, and, if so specified, little tendency to cold flow.

Acrylic plastics are well rated under the following properties: Flexural and tensile strength; color fastness; water, acid, caustic, and solvent resistance; and dielectric strength. They also adapt themselves well to inserts. Typical applications include displays and decorative articles, brush backs, signs, clock and instrument dials, containers, cases, lenses, and the like.

Cast phenolic resins, while not properly classed as molding plastics, are mentioned here for general information. They are known by the trade names of Bakelite Cast Resinoid, Catalin, Gemstone, Marblette, Opalon, and Prystal. They are prepared as a syrup, and the casting process involves pouring this viscous material into lead, glass, or rubber molds, after which the material hardens under heat, generally requiring forty-eight hours or more at about 175 degrees F.

The cast material, when finished, has excellent eye appeal. The colors are unlimited and range from clear transparence to opacity, including many beautiful mottled effects. The castings are often in the form of rods, tubes, or sheets, which are readily machined and polished. The plastic is non-flammable, has high tensile and fair impact strength, and good electrical insulating properties. The applications are chiefly of an ornamental nature, including buttons, handles, knobs, cases, costume jewelry, advertising signs, brush backs, displays, translucent panels, and similar products.

Cellulose acetate, which is manufactured under the trade names of Bakelite Cellulose Acetate, Lumarith, Masuron, Fibestos, Nixonite, Plastacele and Tenite I, is among the most widely used thermoplastic materials. It has good mechanical strength, but is subject to considerable cold flow, especially in the softer grades. It is procurable from clear transparency through any degree of translucency to opacity, and in a wide range of colors.

Cellulose acetate is hygroscopic — that is, tends to absorb moisture—but generally has good to fair acid, caustic, and solvent resistance, depending upon the strength and nature of the solution. Its general moldability is excellent, and it can be molded around inserts without difficulty. It has high dielectric strength and good machining qualities. Acetate plastics are often subject to warpage in service, and they become quite brittle at low temperatures, say, 0 degree F. or thereabouts. Typical applications include handles, knobs, escutcheons, bezels, lighting accessory and electrical appliance parts, combs, costume jewelry, gunstocks, clock and watch crystals, and an array of novelties.

Cellulose acetate butyrate, which has the trade name of Tenite II, is quite similar to the general run of cellulose acetates, except that it has much better resistance to weather and its water absorption is much lower. It also has greater impact strength and less tendency to cold flow. Because of these differences, it finds additional applications in articles such as signs and lenses that are subjected to outdoor exposure, handles, trays, parts used in refrigerators, tooth-brush handles, and parts that are subjected to considerable contact with water.

Cellulose nitrate, known by such trade names as Amerith, Celluloid, Nitron, Nixonoid, and Pyralin, is the oldest of synthetic plastics. This thermoplastic is not suitable for injection molding, partly because the granules do not weld and the finely crushed powder is dangerous to handle and to store. Sheet and bar stock can be compression molded. Hollow articles are made by using softened sheets in the mold, and forcing steam, air, or liquid between them.

This material is somewhat water-resistant, yet is hygroscopic, and so is not suitable for use in continuous contact with water. It is available in crystal clear, translucent, and opaque forms in any color and in many beautiful mottled effects. It is tough, has excellent machining qualities, and finds some applications quite similar to those of cellulose acetate and butyrate. Flammability is its main drawback, but by use of special plasticizers, this property can be reduced considerably. Clear transparent forms become brittle and discolor under prolonged exposure to sunlight. Much sheet, rod, and tubing are worked by machining rather than by molding. Few custom molders work with cellulose nitrate.

Cold molding compounds of the organic type are known by the following (among other) trade names: Aico, Cetec-Non-Refractory, Ebrok, Gummon, Okon, and Thermoplax. The inorganic types include Aico-5, Alphide, Cetec-Refractory, Coldstone and Hemit. These compounds can be further grouped in three classes, depending upon the kind of binder used: (1) Bitumen, which has the lowest physical strength, is cheapest per pound, but has the best molding properties. (2) Resin, with high tensile and compressive strength, but lower heat resistance than bitumen. (3) Cement, having rather low tensile strength, the highest compressive strength, and, being refractory, the highest heat resistance and good arc resistance.

All have relatively low dielectric strength, but good resistance to acids and alkalis, unless concentrated. The moisture absorption of some forms is high, tending to impair the dielectric properties. Battery boxes, terminal and switch blocks, heater plugs, and handles subjected to considerable heat are among the outstanding cold molded articles. All except certain refractory forms are dark in color, and all are opaque. Rather liberal dimensional tolerances are required.

Ethylcellulose, known by the trade names of Dow Ethocel and Hercules Ethylcellulose, is a thermoplastic material having good impact, flexural, and tensile strength. Its hygroscopic qualities, tendency to dimensional change upon aging, flammability, and hardness compare with that of cellulose acetate and of cellulose acetate butyrate.

Ethylcellulose has a complete color range, and is inert to alkalies of all strengths and to dilute acids. Its specific gravity is very low (1.14), and it possesses good dielectric properties. It is readily molded by either injection or compression methods. Molded products from this material are quite similar to the acetates. Ethylcellulose plastics form an excellent coating over wires. Strips of extruded ethylcellulose are used in the manufacture of woven furniture. Ethylcellulose, unlike cellulose acetate, does not become brittle at low temperature.

Melamine, which is closely related to the ureas, is known by the trade name Melamac. This material is of the thermosetting type. It is highly inert, and among its outstanding properties is its resistance to hot water, organic solvents, weak acids, and alkalies. It is odorless and tasteless, colorless, and light-fast.

Phenolic plastics are perhaps the most widely used of all molding materials except rubber, and the following trade names of this type of material are well known to molders and customers alike: Bakelite, Durez, Durite, Indur,

Makalot, Resinox, and Textolite. Phenolic resins from which plastics are made are commonly mixed with about equal parts of fillers, such as wood flour, asbestos, mica, cotton flock, or macerated fabric, which strengthen the molded plastic and impart to it other favorable properties.

These resins are readily molded under heat and pressure, during which they undergo a chemical change. As a result, they become permanently hard and cannot be softened again, even by subsequent heating. They also become insoluble.

Phenolic plastics come in a variety of colors, but these are not generally color-fast; black, brown, and red are among the most stable. Light colors tend to darken, and some others fade more or less rapidly if exposed to sunlight (or ultra-violet radiation) or to moisture.

Besides the properties outlined, phenolic plastics have many desirable characteristics, such as fair to high strength, including high impact strength in some forms only; hardness; good moisture, acid, and alkali resistance; good to excellent dielectric properties; machinability; low tendency to cold flow; fairly high heat resistance; and good buffing qualities. Except for certain cold-molded plastics, the phenolic plastics are the lowest in cost per pound of the plastics now in common use. Not all the properties mentioned are found in all the various grades, but generally a combination of most of them can be secured in one or more types.

Styrene plastics are known by the trade names Bakelite Polystyrene, Lustron, and Styron. This resin is thermoplastic, has a high luster, and is light in weight. It ranges from clear transparency to opacity, and is available in a wide choice of colors. It has excellent resistance to cold flow, except at elevated temperatures, has the lowest water absorption of any plastic, and is inert to acids as well as alkalies. Styrene plastics are not soluble in alcohol, but are soluble in aromatic and chlorinated hydrocarbons. They have the ability to carry light (by internal reflection) around corners, as do the acrylic resins, and thus can be used where edge lighting is desirable.

Typical applications of styrene plastics are generally the same as for acetates or butyrates, but, in addition, their non-hygroscopic qualities give them additional uses. Because of unusually low electrical losses, they are well suited for high-frequency applications. They are suitable also for nameplates and handles, and doors and bin ends used inside of refrigerators. On these, as well as other applications, metal inserts molded into the material should be avoided, as the material surrounding the inserts is likely to crack. Unlike most thermoplastics, the styrene type contains no plasticizer, and this makes for dimensional stability.

Rubber, the molding of which is discussed here, refers chiefly to the "hard" type. The molding process is comparatively slow, the cycles varying from a minimum of approximately ten to twenty minutes up to several hours. One outstanding advantage is that under-cuts of large proportions can be made in soft molded rubber articles. Various pigments added to the molding mixture give a variety of colors, although the standard colors are chiefly black, red, green, or mottled.

The properties of the various grades differ considerably, and the price varies accordingly. Rubber products are generally impervious to acids and the dielectric properties are good. Hard rubber moldings include such parts as storage battery cases and chemically resistant fittings. Rubber moldings have very low water absorption, but soften and swell when in contact with oils, are inflammable, and are subject to attack by ultra-violet light.

Shellac is a thermoplastic resin known by such trade names as Compo-site, Harvite, and Lacanite. It can be molded either by the injection or by the compression method. It has excellent dielectric properties, coupled with oil resistance, and is extensively used for insulators, both large and small. Shellac also has some properties desired in phonograph records, for which it is much used. Although thermoplastic, molded articles can be made to withstand temperatures above 212 degrees F.

Synthetic rubbers or rubber-like plastics, supplied under such names as Neoprene, Koroseal, Thiokol, and others, are becoming available in increasing quantities and in many varieties. In general, they have properties similar to rubber, and most of them can be vulcanized. Most of these materials, unlike natural rubber, are not affected by contact with mineral lubricants, gasoline, and other petroleum products. The molding is done, as a rule, in about the same way as for rubber, but the applications are chiefly for uses where natural rubber would be unsuitable, or would be subject to rapid deterioration.

Urea resins are commercially known as Bakelite Urea, Beetle, and Plaskon. They are thermosetting, usually translucent, and come in a great variety of colors, especially pastel tints and mottled effects. The colors are quite light-fast. Typical applications include closures, radio cabinets, clock cases, handles, lamp shades, and electrical devices. The molded article is light in weight, and though fairly water-resistant, is not recommended for use in continuous contact with water.

Urea moldings are quite brittle. In the lighter shades, the material is translucent; and when thin-walled sections are used, care must be exercised in the choice of design and location of

ribs, so as not to detract from the appearance. Metal inserts, molded in place, can be used, but are not generally recommended, because the material surrounding the inserts will quite frequently crack.

Vinyl resins, known by the trade name Vinylite have been used for several years in compression molding, but recently have been introduced to the trade for injection molding as well. This molding material is thermoplastic, and available in almost any colors ranging from clear transparency to opacity. The water resistance is high, and the dimensional stability excellent. Phonograph records are among the important applications.

Designing Molded Plastic Parts

Many problems have to be solved in the design of most products; those molded from plastics are not an exception. But there are several general rules to aid the designer in adapting the molded part to quantity production. If the designer is familiar with plastic molding practices and the general characteristics and properties of molding materials, the following rules and suggestions may seem more or less self-evident; but it is surprising how often many of them are overlooked or forgotten.

It is always helpful, when designing a product to be molded, to visualize the part in the mold and to consider how it will be ejected. This will make apparent the necessity for adequate draft, and will help to determine whether it is better to have the part cling to the force or to the cavity, and where knock-out pins should be provided. It will also reveal the logical parting of the mold and where the flash will occur. Such study helps to indicate how product costs can be reduced and how mold costs can be minimized without using a mold that is cheap in the sense of being poorly built, for such a mold is seldom a good investment. The part should be so designed that the mold cost is kept at a minimum without sacrifice of quality or of efficiency in operation.

Improvements in molding technique and in plastic molding materials have been so rapid that the average designer is not too well posted. For this and other reasons, it is well for him to consult the engineering staff of a qualified custom molder before his design is too far advanced to permit of desirable changes. The responsible molder is capable and willing to aid in adapting designs to the most economical and satisfactory molding practice. As he works with most, if not with all of the established plastic materials, and knows their properties, his aid in selecting the best material is invaluable. Since the selection of the molding material has a bearing on the mold design and also on the cost of the finished product, it is well to have a definite knowledge of what material is to be used before going far with the design of any parts to be molded from plastics.

It is often expedient to have a qualified commercial designer or "stylist" either design or offer suggestions on those features that affect the appearance of the product. Such designers generally are also prepared to furnish models of the design, and these models often save their cost many times over. Among the advantages of a model is that it can be viewed from an infinite number of angles, whereas the average drawing generally limits the views to three or four. A model also makes it possible to secure constructive criticism from those who cannot read drawings, but whose comments may well prove valuable.

General Rules for the Design of Plastic Parts

It is, of course, impossible to lay down any unvarying set of rules to cover all features of the design of parts for plastic molding. Some general rules can be given, but it must be understood that they are not applicable in all cases. They serve, rather, as a guide to what should be aimed at, especially when the purpose is to produce at minimum cost, than as inflexible rules of what can and cannot be done.

The reasons on which the rules are based are explained, but the rules sometimes have to be violated because of other more important considerations. Nevertheless, they are formulated with a view to reducing both the mold cost and the time of production, and where it is possible to follow these rules and still meet other requirements, costs are likely to be lowered and production speeded. Although some of the rules may appear self-evident, checks of actual designs will show that they are sometimes overlooked, with consequent and often needless increase in cost.

The rules may well be reviewed before designing a part to be molded from plastics; and when the design is nearing completion, if it be checked against each rule successively, it is quite likely that they will suggest desirable changes, which, if followed, will result in economies, often without interfering with other requirements that must be met.

Obviously, the rules are not all-inclusive, and the designer should use reasonable judgment in their application. When there is a question as to their applicability to specific designs or as to the probable effect upon cost if the rule be violated, the designer may well discuss alternatives with the engineer of some molding company, who will know what the effect of the alternative on cost is likely to be.

1. Design for the minimum over-all size of piece, consistent with other requirements, and avoid more parts than economy in production dictates.

2. Aim for uniformity in section thickness, and keep sections as thin as strength and other considerations permit.

3. Avoid deep draws when shallower ones meet the requirements.

4. Aim for simplicity in general design and for shapes that tend to minimize the cost of molds.

5. Design the piece so that the mold parting will come where the flash is readily removed and where the mark left is not noticeable or where it can easily be removed, as by buffing.

6. Choose the material that gives lowest over-all cost consistent with other requirements.

7. Design for the simplest and most rapid molding consistent with other requirements.

8. Avoid shapes that require molds having split sections or other loose pieces, when simpler molds can be made to meet the requirements.

9. Allow plenty of draft to facilitate removal of the molding from the mold.

10. Provide for ample fillets at inside corners.

11. Avoid large flat areas, especially where crowned or curved surfaces, beads, stepped, or other "broken" surfaces improve appearance without undue increase in cost.

12. Avoid the use of inserts molded in place unless essential; and where they are required, minimize their number.

13. When inserts are required, see that they are not fragile or easily displaced and that there is sufficient plastic around them to avoid cracking of the plastic subsequent to molding.

14. Avoid specifying limits closer than are readily held or closer than are required in mating parts.

15. Design the piece to facilitate ready removal from the mold without distortion and so that push-out pin marks, which are unsightly, are hidden in the finished product.

16. Make use of integral projections or recesses where they tend to facilitate assembly or fastening without undue increase in cost.

17. Design for best appearance consistent with cost limitations.

18. When lettering is required, specify raised letters; use debossed letters in the piece only when required for "wiping in" or for reasons that justify the added cost. This applies when the cavities are sunk by machining. If they are produced by hobbing, debossed letters should be specified.

19. Locate lettering on mold surfaces that are accessible, and preferably on surfaces parallel to the mold parting.

20. Always use inserts for threaded holes if considerable stress is to be imposed on the threads or if they are subject to considerable wear.

21. Avoid long cored holes (especially side holes), particularly if adequate support cannot be provided for the pin that forms the hole.

22. Always have inserts as sturdy as expedient, and avoid specifying long inserts or slender inserts supported only on the ends.

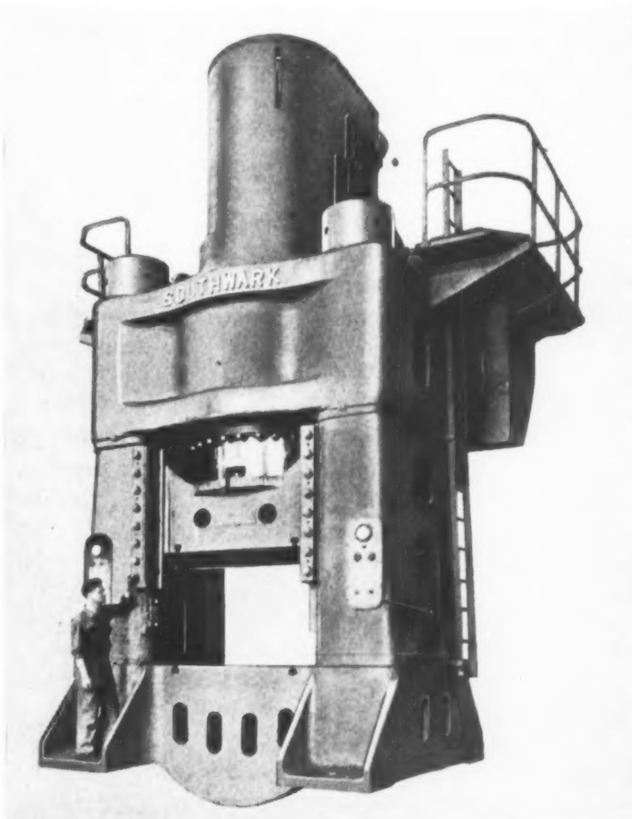
23. Avoid lugs or projecting inserts near edges or corners.

24. Do not specify oblique or irregular holes if they can be avoided.

25. Avoid the use of hexagonal or irregular shaped inserts in those portions that project from the molded part.

26. Avoid inserts that project from the molded piece at both ends if the ends must telescope into both halves of the mold.

27. Design the molding, if possible, so that the mold can be parted in one plane rather than with an irregular parting.



A 4000-ton Press Built by Baldwin-Southwark for High-speed Embossing Operations. Push-buttons Provide for Fully Automatic or Semi-Automatic Cycles, and a Large Hand-lever Permits the Press to be Operated Manually if Desired. Four Electric Eyes are Installed on the Front and the Rear of the Press to Safeguard the Operators

Successful Method of Putting Idle Equipment to Work on Munitions

MUCH has been written about the necessity for putting idle machine tool capacity to work in connection with the munitions program. Many plans have been prepared and much work has been done on paper to further this idea; but it has been reserved to a comparatively few enterprising manufacturers to put the idea to practical use and to actually enlist idle machine tool capacity in munitions manufacture on a practical basis.

One company that has done this with marked success is the York Oil Burner Co., York, Pa. The general manager of this company, S. H. Shipley, found that he could obtain a sub-contract from a large manufacturer of heavy war equipment, provided he could enlist other plants, owning large boring mills to assist him. In his own plant he had only one large boring mill. New boring mills could not be purchased, because heavy boring mills are in great demand in connection with munitions manufacture.

Mr. Shipley reasoned that there must be a great many boring mills in plants having such equipment that are not employed to full capacity in connection with the regular work for which they are used. Often one finds in plants where boring mills are a necessary part of the equipment that they are operating perhaps only two or three days a week. Now, if the remaining idle capacity could be made use of, the work required to be done could be performed without buying any new boring mills, provided the work was brought to the plant where the mills were.

The next step, then, was to find out what plants within a radius of 150 miles or so had boring mills of from 7- to 10-foot capacity. In an emergency, mills as small as 5 feet could be used with special provisions for tooling. In due time, Mr. Shipley located thirty boring mills in eighteen different plants in twelve different cities that had sufficient idle capacity to take care of the sub-contract that he could obtain. From these boring mills, he was able to obtain 60 per cent of their available time. If these mills were operated twenty-four hours a day, seven days a week, this capacity could be increased 75 per cent.

To give an idea of how scattered these available boring mills are, it may be mentioned that they are located in plants in Scranton, Pottsville, Reading, Downingtown, Coatesville, Lancaster, Harrisburg, Chambersburg, Frederick, Waynesboro, York, and Hanover, Pa.

The work to be machined consists of large forgings, which are first rough-turned and then finish-turned. The rough-turning and finish-turning are not always done in the same shop—frequently not in the same town—because some of the mills available are not suitable for the finish-turning operation. When the machining is completed, the machined forgings all come to the plant of the York Oil Burner Co., where the assembly work and final inspection are done.

An important point in connection with this method of making use of available idle capacity of machine tools through "sub-contracting a sub-contract" is that any such procedure requires a great deal of supervision and coaching. The original sub-contractor must provide training of the operators in all the eighteen plants, and must also provide the required supervision and inspection.

In most cases, the manufacturers in whose plants these mills were available were not anxious to undertake the work, because they did not think that they were quite fitted to do so, and some had to be encouraged to assume the responsibility. In some instances, the training work had to be quite intensive and carefully done, since, obviously, these large forgings are costly and the contractor could not afford to have them scrapped because of faulty machining. However, through the methods that have been applied in this case, the sub-contract is being successfully completed, and it is expected that new contracts will be undertaken on possibly an even larger scale.

* * *

Aircraft Meeting of Society of Automotive Engineers

At the national aircraft meeting held by the Society of Automotive Engineers in New York City March 12 and 13, ten technical papers by sixteen aeronautical engineers were presented. One of the papers gave a detailed account of a German "Junkers 211-B," 1000-H.P., twelve-cylinder, liquid-cooled aircraft engine, which was shot down in action and shipped to this country. The aircraft engine testing techniques used by Ford, Packard, Allison, and Buick were described at another session. Fuel consumption, lubrication, and "crash-proof" fuel tanks were other subjects discussed at the meeting.

Edward P. Bullard, Jr., Completes Fifty Years with His Company

EDWARD P. BULLARD, Jr., president of the Bullard Co., Bridgeport, Conn., on March 10 completed fifty years of participation in the firm founded in 1880 by his father. Mr. Bullard was born in 1872 in Columbus, Ohio. He received his education at the Williston Seminary, Easthampton, Mass., and at Amherst.

In 1892, after he had graduated from Amherst, he entered his father's plant in Bridgeport, and served a complete apprenticeship at 5 cents an hour. Succeeding generations of the Bullard family have continued to serve similar apprenticeships. At the time that Mr. Bullard completed his shop training, the firm employed 55 people; today it employs 5000. This working force is built around a large nucleus of men trained in accordance with an apprentice program that has been maintained by the Bullard Co. throughout the years and that even the depression did not cause the firm to discontinue.

When, through his apprenticeship and additional training, Mr. Bullard had become familiar with all the details of the company's work, he spent two years in Europe selling and demonstrating machine tools.

More than forty years ago, the company applied the turret principle to boring mills, adapting this type of machine to repetitive work. In 1900, Mr. Bullard carried the principle further in the design of a vertical turret lathe which was first applied to automobile production in the Panhard Works. In this machine, he used continuous-flow forced lubrication, which was a new idea in machine tools at that time. This machine proved so successful in automobile production that a larger size was designed for railway shop work.

In 1913, Mr. Bullard developed the first vertical multi-spindle Mult-Au-Matic, which has now become what may well be designated a standard machine tool in the automobile and other mass production industries. This machine was followed by the Contin-U-Matic in 1922. The latter machine carried the principle of simultaneous operations in one machine still further.

For his achievements in the machine tool industry, Mr. Bullard has been awarded the medal of the Franklin Institute; and at the annual meeting of the American Society of Mechanical Engineers in December, 1937, he was awarded that Society's medal for his work in connection with the development of the Mult-Au-Matic. From 1911 to 1913, he was president of the National Machine Tool Builders' Association.

At the present time, the firm's output of machine tools is entirely for war production purposes. This, in a sense, carries out a tradition started when Mr. Bullard's father was recalled from the Northern Army in the Civil War to make pistols at the Colt Armory in Hartford. The tradition was continued in the first World War, when the Bullard plant turned out machine tools for war work and 155-millimeter guns for the Allies.

On the day that marked Mr. Bullard's fiftieth anniversary in the machine tool industry, he was greeted by eighteen associates, the average length of service of each of whom is forty-four years. This large number of men with long service records Mr. Bullard regards as a typical result of the industrial policy pursued by him.

* * *

List of American Standards for 1942

The American Standards Association has published its new list of American Standards for 1942. Nearly 500 American Standards are listed in a wide variety of industrial fields. There is a separate heading for the American Defense Emergency Standards — standards developed specifically for defense purposes—and for the first time, all American Safety Standards are listed together in a separate section. This list of American Standards for 1942 will be sent free of charge to anyone writing for it. Requests should be addressed to the American Standards Association, 29 W. 39th St., New York City.

Norton Company Receives the Navy "E" Award

On March 23, the Norton Co., Worcester, Mass., officially received the Navy "E" award in recognition of outstanding "production achievement." As is well known, this symbol of efficiency and excellence is the highest service award that the United States Navy can bestow either on a ship or a manufacturing enterprise. An "E" painted on the funnel, turret, or conning tower of a Navy ship designates distinguished gunnery, engineering, or other outstanding performance. The idea of honoring manufacturers and workers for conspicuous co-operative and efficient production of material for the Navy was suggested by Rear Admiral W. H. P. Blandy, Chief of the Bureau of Ordnance. It is a recognition of independent effort by industry in solving difficult ordnance production problems.

The presentation of the award was made on March 23 by Admiral Wat Tyler Cluverius; the award was accepted on behalf of the Norton Co. by the company's president, George N. Jeppson. It was also accepted on behalf of the Norton employes by P. Joel Styffe (who has been with the company since 1891), representing the workers of the Abrasive Division, and Leonard R. Cutler, representing the workers of the Machine Division.

* * *

An Unusual Eye-Shade

A new eye-shade made by the Edroy Products Co., 480 Lexington Ave., New York City, is equipped with a pair of stereoscopic five-power magnifying lenses. By a slight tilt of the head, the subject observed is brought into focus greatly magnified; but the wearer, when not using the lenses, can readily look beneath the shade with his normal vision. It also affords him the use of both hands instead of one, as with the old-fashioned magnifying glass.

New Type of Eye-shade Provided with Stereoscopic Five-power Magnifying Lenses

* * *

How Small Industries Can Go After War Work

The Copper & Brass Research Association, 420 Lexington Ave., New York City, has published a booklet entitled "How Small Industries Can Go After War Work." The purpose of this booklet is to give information to small companies on how to obtain contracts or sub-contracts through the Contract Distribution Branch, Production Division, War Production Board, Washington, D. C., or through the regional offices in various cities. The information includes how industry can secure loans for equipment to make war armaments, how small companies can form pools to obtain contracts and other helpful data. A list of regional offices and addresses, together with the names of officers and telephone numbers, is included. A copy of the book can be obtained without charge by writing to the Association at the address given above.

* * *

Chart for Selecting Welding Fluxes

The importance of fluxes is thoroughly recognized by all who have to do with welding, brazing, and soldering. A large number of fluxes have been developed, each one particularly suited to a certain application. The selection of the particular flux that will produce the best results is frequently difficult. To facilitate this selection, Krembs & Co., 669 W. Ohio St., Chicago, Ill., has brought out a chart that gives quick answers to some four hundred fluxing questions. Concerns engaged in metal-working can obtain copies of this chart free of charge.

* * *

Production Control Charts

The Wassell Organization, Westport, Conn., has developed a method of production control known as "Produc-Trol." This system of production control can be used to schedule the entire production procedure from the raw material to the final assembly. It shows, in chart form, results compared with the original schedule, and enables the production manager to focus attention on items that are behind schedule.

Management and Labor Must Win the War Through Production

Extract from an Address by James F. Lincoln, President of the Lincoln Electric Co.

WE, as a nation, are facing the most serious problem in our history. For the first time in one hundred and fifty years we are at war with an enemy whose fighting ability is equal to our own, and, what is more, whose manufacturing production exceeds our present output.

Modern wars are won in the factory, not on the battlefield. What happens on the battlefield is the result of previous preparation and foresight in the factory. Our enemies are exerting themselves to the limit because they know their future depends on their production. However, in the case of the democracies this is not true. The majority of our people are concerned mainly, as the President has said, "in maintaining our so-called social gains." The war has been made secondary to these social gains.

It is obvious that anything which interferes with the efficiency of our production will prevent us from winning against our enemies, because they have no such preconceived limitations—they are going to win or die.

No One Class Can Expect to be Exempt from Sacrifice

Our method of retaining our so-called gains actually means, in terms of production, that management does not manage industry. That is done by the representatives of the workmen. Management, through experience and ability, knows how to increase production — labor, because of union rules or because of preconceived notions, will have none of it. Management could increase production by a new and better technique—labor leaders to a large extent fail to cooperate. Management can make the tools to win this war—labor, with its present power, will not go along.

We cannot win against an intelligently and imaginatively led people of equal manufacturing ability if ruled by a chaotic, undisciplined, uncooperative mass of individuals, armed with the power given them by the present Government. We have the ability in management, as has been demonstrated over the years, to build better products in a shorter time and at a lower cost than any competitive nation; but to do that we must use the ability, the experience, and the imagination of our present industrial management to the fullest in accomplishing just exactly that end.

Instead of doing that at the present time, we are using that management for the clearing up of minor bickering between various trades, between various men in the same trade, and between various individuals. If the present chaotic industrial condition is the only way that our so-called "social gains" can be retained, we can be sure they will disappear in the certain defeat which faces us in the present war.

Our First Battle is against Selfishness on the Home Front

The first thing we must do to win the war is to win the battle with ourselves and become a united industrial nation with the ability of managing the production of willing, enthusiastic, and disciplined workmen, whose ideal is efficiency and whose watchword is "cooperation."

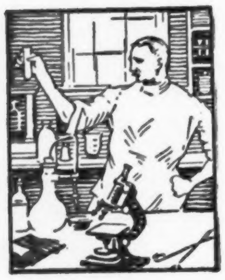
The wage rates now paid, which are widely varying even in the same trade, are higher than they have ever been for workmen in this or any other country, at this or any other time. Wage rates, however, are not the important condition for the successful operation of industry. It is necessary that these wage rates reflect the production ability of the individual rather than the amount of time, the time of day, or the time of week that he is in the factory.

If we put a premium on inefficiency, as the present set-up does, we are putting a tremendous temptation in the way of the workman to take advantage of the situation so as to make his income a maximum with a minimum of production.

Management must manage because management only can direct the factory operation. Labor must take this direction without question and with maximum effort to accomplish the required end. With this only can we win the war.

Another essential to success is that we gather to the top, in the direction of this war, the men with the most ability to develop new tools of war. It is not possible to win a modern war by merely duplicating what our enemy does; yet we have done only this so far. Competition in armaments will follow the same pattern for success as completely as any other competitive activity. Doing what our competitor does is not enough. We must lead if we are to win!

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

A Light-Weight Refractory that Can be Cast

A light-weight insulating refractory that can be cast is announced by the Plibrico Jointless Firebrick Co., 1800 Kingsbury St., Chicago, Ill. This material—known as Plicast L-W-1—is suitable wherever refractoriness in combination with good heat insulation is required, as its thermal conductivity is less than 30 per cent that of ordinary firebrick. It is recommended for service temperatures as high as 2200 degrees F. As cast, this material weighs approximately 50 pounds per cubic foot after drying. This is 60 per cent lighter than firebrick, which usually weighs about 125 pounds per cubic foot. Thus, the weight of the supporting steel work can be reduced.

Within its temperature range, Plicast L-W-1 is suitable for use as a refractory lining in heat-treating, annealing, stress-relieving, carburizing, and other types of industrial furnaces. It also can be utilized in boilers for burner blocks, ducts and breechings, water walls, etc. It is supplied in dry powder form ready for mixing with water. When mixed, it is poured into molds or forms of any desired shape, and sets without the application of heat. Twelve to twenty-four hours after mixing, it is ready for service...201

Zinc Phosphate Coating Provides Rust Protection

A process for protecting metals against rust, designated "Irco Zinc Coat," has been developed by the International Rustproof Corporation, 12507-15 Plover Ave., Cleveland, Ohio. This chemical treatment for metal surfaces provides a rust inhibiting base of zinc phosphate for paint, enamel, or lacquer finishes. The process can also be used to build up added protection over galvanized metal.

The zinc phosphate coating is applied by dipping the metal, after it has been cleaned, into a bath of the processing solution which is maintained at a temperature of 180 to 190 degrees F. The immersion period varies from five minutes to one hour, depending on the depth of coating desired. A water rinse completes the process. In addition to being used as a paint base, "Irco Zinc Coat" can be used as a final finish by the use of a longer immersion period and an oil dip. The finish obtained by this means is said to be comparable to cadmium or zinc plate.......202

New Non-Metallic Substitute for Aluminum

Development of a new non-metallic material one-third lighter than aluminum and designed to replace that metal in many important defense uses was recently announced by the United States Rubber Co. The new substance, which is made from fibrous and rubber-like ingredients, has been tested and approved by the United States Army, according to company officials. Of prime importance, in view of the present emergency, is the fact that, except for small amounts of rubber, the new formula is made of non-strategic materials, and will not be affected by priorities.

In many qualities, the new material, which is known simply as Formula C-102, is claimed to surpass aluminum itself. Under gunfire, for example, it resists ripping or shattering. It will not crystallize from vibration, as metallic substances do, and it is also free from corrosion and the formation of pin-holes.

Discovery of this important new substance was made while members of the research department were working on bullet-puncture sealing fuel tanks. Seeking a container for the tanks that would have all the advantages of aluminum, including lightness, and yet have greater resistance to shattering when struck by bullets, the scientists experimented with many different combinations. Formula C-102, as developed for use, is slightly thicker than the 1/8-inch alu-

To obtain additional information about materials described on this page, see lower part of page 212.

minum sheets used in the gasoline tanks, and is one-third lighter. It permits penetration of gunfire with little tearing and with maximum support to the sealing compounds used.

The company stressed the fact that, in addition to this and other contemplated defense uses, the new material is expected to find many applications in normal industry. One of these may be as a substitute for aluminum panels now used in bus and truck body construction. 203

Piercing Compound Useful in Shell Production

For use in making shells or other products in which the hot piercing of forgings is accomplished, the Quaker Chemical Products Corporation, Conshohocken, Pa., has placed on the market a compound known as Quaker Piercing Compound No. 10. This product is sprayed or swabbed on the punches, and is said to provide excellent lubrication; even at extremely high temperatures. Besides preventing the punch from sticking, it increases the punch life, practically eliminates pitting, and insures that the work is left clean after the operation......204

Electrically Welded Stainless-Steel Tubing Now Available

A new electrically welded stainless-steel tubing designated "Gloweld," which provides a high degree of corrosion resistance and strength, with minimum weight and uniformity of structure, has recently been announced by the Globe Steel Tubes Co., 3839 W. Burnham St., Milwaukee, Wis. The method of welding the stainless strip produces a tube with very little flash, thereby reducing to a minimum the grinding or cutting of flash to obtain a smooth finished tube. The structure of the weld metal closely approximates the structure of the tube itself. The new welded tubing can be readily bent, coiled, swaged, and formed.

Tubing of this type has been adopted in aircraft construction for hydraulic lines and structural and engine parts where the greater corrosion resistance of stainless steel is needed, together with light weight and strength. Gloweld will be available in a wide range of diameters and wall thicknesses, and in practically all of the stainless-steel analyses. 205

Plastic Material Used in Place of Copper for Tubing

A flexible semi-transparent tubing of thermoplastic "Saran," manufactured by the Dow Chemical Co., Midland, Mich., has been found suitable as a substitute for small copper tubing in applications not requiring high temperatures or very high pressures. This plastic tubing is characterized by unusual toughness and resistance to moisture, brine, solvents, acids, and alkalies. It can be used for short periods of time at temperatures of 250 to 275 degrees F., although at these high temperatures its strength and resistance are somewhat reduced. It has also been found to possess excellent fatigue resistance.

It is available in sizes of 1/8 to 5/16 inch outside diameter, with wall thicknesses ranging from 0.030 to 0.062 inch. This tubing can be joined by Parker standard tube couplings and S A E or other flare type fittings. When joined by "B" Parker standard tube couplings, the tubing withstood a pressure of 1500 pounds per square inch without rupturing or leaking...206

This bench, used in the research laboratories of the General Electric Co. at Schenectady, N. Y., for polishing metallographic samples, is constructed entirely from stainless steel. It was fabricated in the machine shop of the research laboratory. The advantage gained by using stainless steel is the cleanliness of the working area, which is extremely important if the surfaces of the metal specimens are to be kept free from scratches and other imperfections

To obtain additional information about materials described on this page, see lower part of page 212.

NEW TRADE  LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Fill in on Form at Bottom of Page 211 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the April Number of MACHINERY

Calculator for Heat-Treatment of Alloy Steels

PETER A. FRASSE & CO., INC., 17 Grand St., New York City, is distributing a circular chart for calculating the heat-treatment of alloy steels. These calculators show physical properties of various alloy steels at six different draw temperatures, as well as the effect of mass at 1000 degrees F. draw. 1

Automatic Precision Thread Millers

U. S. MACHINE TOOL MFG. CORPORATION, 100 S. Sixth St., Terre Haute, Ind. Bulletin illustrating and describing the Clinton automatic precision thread millers, designed to cut left- and right-hand threads, either on the inch or metric system, internally as well as externally. 2

Nitriding Steels

NITRALLOY CORPORATION, 230 Park Ave., New York City. 40-page data book containing tables, charts, and data covering the composition of nitriding steels, preliminary treatment, physical properties, the nitriding process, properties of nitrided Nitralloys, and machining of nitriding steels. 3

Metal Cleaning in Maintenance Work

OAKITE PRODUCTS, INC., 26 Thames St., New York City. Bulletin covering a digest of twenty-eight essential maintenance jobs generally performed in factories and mills, on which Oakite materials are being successfully used to save time, money, and effort. 4

Wrought-Iron Pipe, Tubes, and Hot-Rolled Products

A. M. BYERS CO., Pittsburgh, Pa. General catalogue covering the company's complete line of wrought-iron pipe and tubular products, wrought-iron hot-rolled products, welded-steel tubular products, standard alloy steels, and heat-resisting steels. 5

Grinding Hints

NORTON CO., Worcester, Mass., is distributing semi-monthly a cartoon style bulletin containing helpful hints on grinding, designed primarily for defense plants employing new grinding operators. These bulletins are available to all interested in grinding. 6

Interchangeable Ball Bearings

UNITED MOTORS SERVICE, INC., General Motors Bldg., Detroit, Mich. Booklet R, Form A-58, listing all standard New Departure ball bearings, together with the bearing numbers of competitors' bearings with which they will interchange. 7

Stainless Steel

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Data sheet giving, in tabular form, the analysis, physical and electrical properties, heat-treatment, mechanical properties, heat resistance, and working of Rezistal stainless steels. 8

Arc-Welding

HOBART BROTHERS CO., Troy, Ohio, is publishing a new magazine entitled "Hobart Arc-Welding News," containing articles on arc-welding and its applications, including those that have been submitted in the Hobart Arc-Welding News Contest. 9

Industrial Lubricating Equipment

ARO EQUIPMENT CORPORATION, Bryan, Ohio. Catalogue illustrating and describing this company's line of high-pressure lubricating equipment, including pneumatic, electric and hand-operated units in both stationary and portable models. 10

Air-Conditioning and Refrigeration

YORK ICE MACHINERY CORPORATION, York, Pa. First issue of a house organ entitled "Cold Magic," which will be published quarterly, containing technical articles and news of the York Ice Machinery organization. 11

Machine Tools and Oil Industry Equipment

AXELSON MFG. CO., 6160 S. Boyle Ave., Los Angeles, Calif. First issue of a house organ known as "Axelson Contact," commemorating the company's half-century of service to the oil industry. 12

Turret Attachments

JEFFERSON MACHINE TOOL CO., Fourth, Cutter, and Sweeney Sts., Cincinnati, Ohio. Circular on tail-stock turrets and toolpost turrets by means of which engine lathes can be converted for turret lathe operations. 13

Bronzes

AMPCO METAL, INC., 1745 S. 38th St., Milwaukee, Wis., is distributing a table of "Bronze Specifications to Government Requirements," giving composition and designation of bronze used by various organizations. 14

Marking Devices

NEW METHOD STEEL STAMPS, INC., 145 Jos. Campau St., Detroit, Mich. Catalogue covering the line of marking devices made by this company and their application on a variety of work for both machine and hand marking. 15

Indexing and Free-Wheeling Clutches

MORSE CHAIN Co., 7601 Central Ave., Detroit, Mich. Bulletin K-6, on indexing and free-wheeling clutches, giving engineering data on power-speed ratios, load capacities, etc. 16

Carbon Tool Steel

JESSOP STEEL Co., Washington, Pa. Circular describing the hot-working and heat-treatment of Jessop "Lion Extra" carbon tool steel, together with list of typical applications and recommended tempers for each. 17

Turret Lathes

WARNER & SWASEY Co., Cleveland, Ohio. Publication entitled "Behind the Smoke of Industry," illustrating and describing turret lathe applications in many different industries. 18

Attachments for Maxi-Production Lathes

CINCINNATI LATHE & TOOL Co., Oakley, Cincinnati, Ohio. Bulletin illustrating and describing attachments and tooling for Cincinnati Maxi-Production lathes. 19

Milling Machine Attachment

EXPERIMENTAL TOOL & DIE Co., 12605 Greiner Ave., Detroit, Mich. Folder illustrating and describing the universal "Slot Master" milling machine attachment. 20

Carboloy Standard Tools and Blanks

CARBOLOY COMPANY, INC., 11147 E. Eight Mile Road, Detroit, Mich. Catalogue GT-140, covering the Carboloy line of standard tools and blanks for cutting steel, cast iron, bronze, aluminum, etc. 21

Die-Casting Machines

PHOENIX MACHINE Co., 2711 Church Ave., Cleveland, Ohio. Catalogue describing the complete line of Lester-Phoenix die-casting machines for zinc, tin, aluminum, brass, and magnesium. 22

Dust Collectors

AMERICAN FOUNDRY EQUIPMENT Co., 555 S. Byrkit St., Mishawaka, Ind. Catalogue 72, containing 58 pages on "Dustube" dust collectors —both knocked-down and assembled types. 23

Covers for Ball and Roller Bearings

R-S PRODUCTS CORPORATION, 4530 Germantown Ave., Philadelphia, Pa. Bulletin 11-C, containing data on standard covers for ball and roller bearings. 24

Conveyors

ALVEY CONVEYOR MFG. Co., St. Louis, Mo. Catalogue 105, illustrating the various types of conveyors made by this company and their application on a wide variety of work. 25

Drawing Reproductions

PARAGON-REVOLUTE CORPORATION, 77 South Ave., Rochester, N. Y. Folder on the Revolute 8F continuous copier, a photo copy machine giving clear contact prints of tracings. 26

Materials-Handling Equipment

BARRETT-CRAVENS Co., 3255 W. 30th St., Chicago, Ill. Catalogue 501 (160 pages and over 400 illustrations), covering a wide line of industrial materials-handling equipment. 27

Lighting Equipment

GENERAL ELECTRIC Co., Lamp Department, Nela Park, Cleveland, Ohio. Booklet entitled "How Light Can Help," showing how correct lighting can help the war effort. 28

Motors and Controls

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Booklet A-3023, describing many phases of research, production, and testing of motors and controls. 29

Plated Metals

AMERICAN NICKELOID Co., Peru, Ill. Folder containing actual samples of prefinished (plated) metals, showing what each finish is like. 30

Electric Control Equipment

AMERICAN AUTOMATIC ELECTRIC SALES Co., 1033 W. Van Buren St.,

- -

To Obtain Copies of New Trade Literature

listed on pages 210-212 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name .... *Position or Title* ....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm ....

Business Address ....

City .... *State* ....

[SEE OTHER SIDE]

Chicago, Ill. Catalogue 4071-C, on relays and other devices for electrical control. 31

Chucks

WESTCOTT CHUCK CO., Oneida, N. Y. Catalogue 540, covering a complete line of independent, universal, and combination lathe chucks, drill chucks, and boring tools. 32

Machine Tools

J. L. LUCAS & SON, INC., Bridgeport, Conn. Bulletin showing the facilities of the company in manufacturing and rebuilding machine tools. 33

Stamping Trimmers

QUICKWORK-WHITING DIVISION, WHITING CORPORATION, 15673 Lathrop Ave., Harvey, Ill. Bulletin QW-107, on stamping trimmers for saving press time and die costs. 34

Electric Remote Speed Indicator

REEVES PULLEY CO., Columbus, Ind. Bulletin G-427, on electric remote speed indicator for variable-speed control equipment. 35

Shapers

GENERAL ENGINEERING & MFG. CO., St. Louis, Mo. Catalogue GC-11, and Bulletin GC-12, on Gemco multi-purpose, Lubrigard-protected crank shapers. 36

Design for Welding

LINCOLN ELECTRIC CO., Cleveland, Ohio. Application Sheet No. 79, describing the changing over of press uprights for welded steel construction. 37

Motors for Aircraft Service

GENERAL ELECTRIC CO., Schenectady, N. Y. Circular GEA-3674, descriptive of motors for aircraft service, in fractional-horsepower frame sizes. 38

Fabric Bearings

GATKE CORPORATION, 228 N. La Salle St., Chicago, Ill. Catalogue HB-520, describing molded fabric bearings and performance results on typical applications. 39

Mechanical Conveyors

STANDARD CONVEYOR CO., North St. Paul, Minn. Bulletin 65, entitled "Standard Conveyors, First Line Equipment in Armament Production." 40

Cleaning Materials

MAGNUS CHEMICAL CO., Garwood, N. J. Technical bulletin 51, on the proper care and cleaning of hands and arms in industrial plants. 41

Transformers

UNITED TRANSFORMER CO., 150 Varick St., New York City. Catalogue entitled "Transformer Components—5000 New Designs." 42

Gear-Shaper Cutters

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit, Mich. Treatise on gear shaping and shaper cutters in the company's publication entitled *"Production Highlights."* 43

Power Transmissions

POWER TRANSMISSION COUNCIL, INC., 53-63 Park Row, New York City. Booklet entitled "Modern Mechanical Power Transmission for Industry." 44

Metal Duplicating Without Dies

O'NEIL-IRWIN MFG. CO., Minneapolis, Minn. Catalogue 42-1, on the Di-Acro system of metal duplicating without dies. 45

Cleaning and Rinsing Solutions

L & R MFG. CO., 54 Clinton St., Newark, N. J. Leaflet describing various types of cleaning and rinsing solutions. 46

Pyrometers

C. J. TAGLIABUE MFG. CO., Park and Nostrand Aves., Brooklyn, N. Y. Catalogue 1101 G, on electric thermometers and pyrometers. 47

Strain Gages

GENERAL ELECTRIC CO., Schenectady, N. Y. Booklet GEA-3673, on electric gages for measuring mechanical strains. 48

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 213-230 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in April, 1942, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 208-209, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in April, 1942, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Fellows Gear-Finishing Machines

The Fellows Gear Shaper Co., Springfield, Vt., has recently placed on the market two gear-finishing machines, designated the Nos. 12 and 24. The No. 12 machine, shown in Fig. 1, is designed for compactness and rigidity, and is arranged with complete electrical control. It is operated through push-buttons located at the front of the machine. These buttons control the rotation of the tool in both directions, as well as the reciprocation of the tool.

The gear-finishing tool is advanced into the work by a feed cam, the standard cam being so arranged that the tool makes two complete cycles and then stops automatically. The stroke length of the reciprocating tool-slide is controlled through dogs and micro-switches. Safety switches are included for stopping the machine automatically in case of failure of the other units. A timing switch governs the period of dwell at the ends of the stroke, where reversal of direction of the finishing tool takes place.

The No. 24 gear-finishing machine differs slightly in design from the No. 12, as shown in Fig. 2, but is provided with similar electrical control apparatus and is operated by push-buttons. On both of these machines, the work is supported on live centers, held in adjustable headstocks and tailstocks. The table carrying these headstocks and tailstocks is adjustably mounted on the base, so that any taper in the gears can be corrected.

Capacities for the No. 12 gear-finishing machine are: Maximum pitch diameter, 12 inches; face width, 3 inches; and diametral pitch, 6. For the No. 24 machine, the capacities are: Maximum pitch diameter, 24 inches; width of face, 5 inches; and diametral pitch, 4. 51

Cleaner for Aluminum and Magnesium

A new cleaner for aluminum and magnesium has been developed by the Hanson-Van Winkle-Munning Co., Matawan, N. J. The cleaner is known by the name "Mattawan AL." It is designed for cleaning either aluminum or magnesium in the form of sheets or castings. Used at a concentration of 4 ounces per gallon at 160 degrees F., it does not produce any etch or weight loss on aluminum sheets or castings after two hours immersion. Machined and polished magnesium shows no weight loss in fifteen minutes. This cleaner is especially suitable for aircraft parts. 52

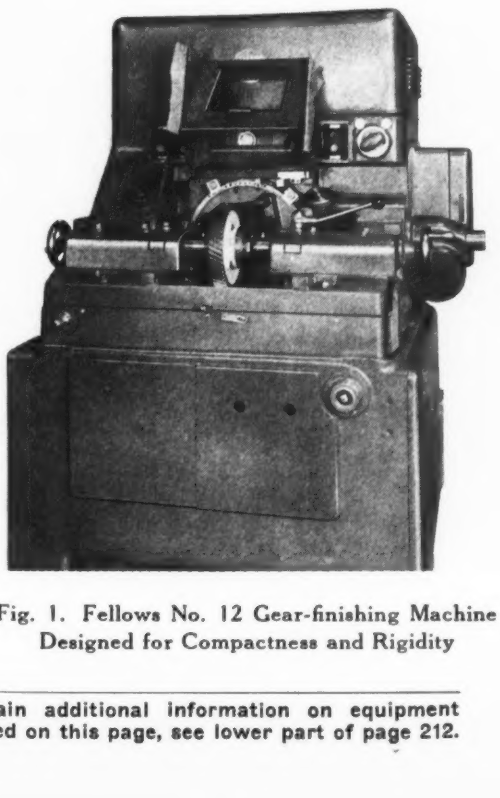


Fig. 1. Fellows No. 12 Gear-finishing Machine Designed for Compactness and Rigidity

Fig. 2. Fellows No. 24 Gear-finishing Machine for Gears up to 24-inch Pitch Diameter

To obtain additional information on equipment described on this page, see lower part of page 212.

Fitchburg Multiple Precision Grinders for Gun Barrels and Spindles

A gun-barrel and long-spindle grinding machine incorporating the Fitchburg Bowgage self-contained automatic grinding wheel units arranged for multiple precision grinding has been brought out by the Fitchburg Grinding Machine Corporation, Fitchburg, Mass. The wheel-head units of the new machine are mounted on special bases to suit the work to be ground.

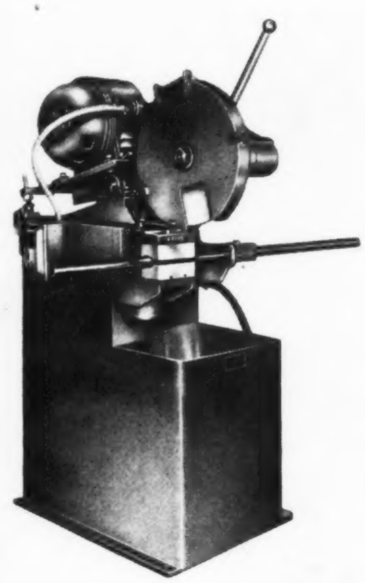
The double- and triple-head machines are particularly adapted for spot-grinding gun barrels and long spindles that require back-rests and subsequent turning operations. Rough forgings which have previously been centered can be ground directly from the rough or from rolled stock. A single push-button controls the cycle of all the Bowgage heads, although in the case of rough forgings, it is sometimes necessary to feed the wheel-heads in by hand until contact is made, and then engage the automatic cycle. The Bowgage heads are mounted on ways, so that they can be located longitudinally in different positions. This permits spot-grinding a variety of gun barrels or spindles.

Grinding all the diameters concentric in the same set-up simplifies subsequent turning operations. The single set-up also eliminates the necessity for handling the work two or more times. All the Fitchburg Bowgage-head precision grinding-wheel units are standard and interchangeable. If the operations for which they are being used are discontinued, the heads can be employed for new work on standard machines or they can be regrouped and remounted on other multiple-head machines. 53

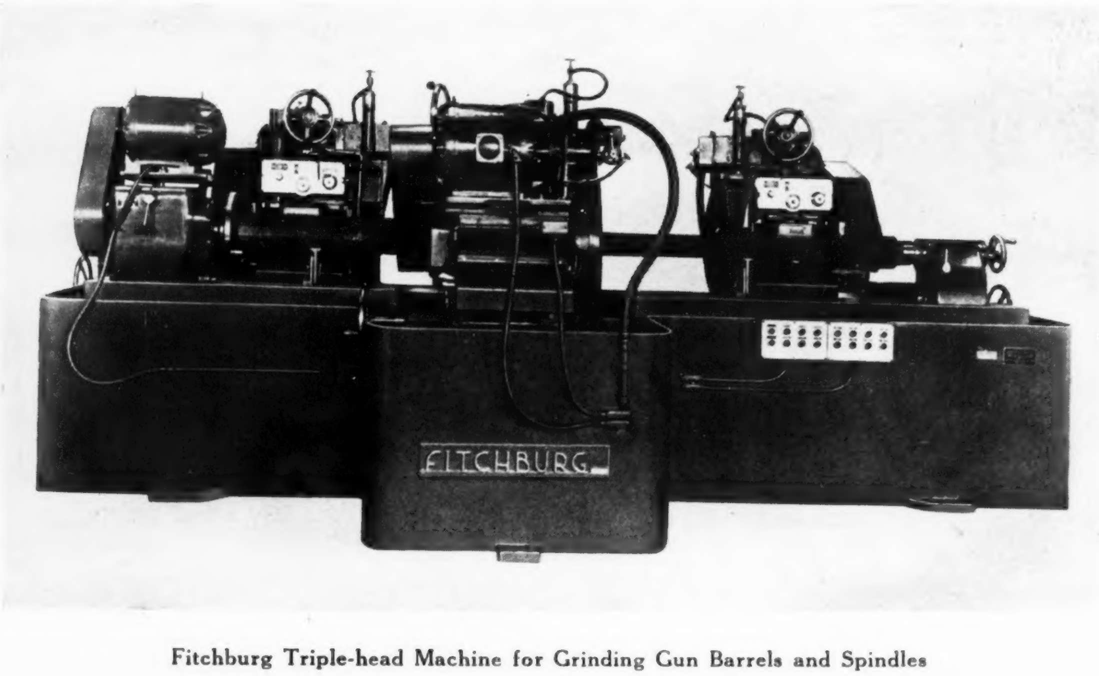
Pines Semi-Automatic Cut-Off Machine

The Pines Engineering Co., 123 Main St., Batavia, Ill., has brought out a Series 500 semi-automatic cut-off machine designed for accurate high-speed cutting of tubes, rods, or shapes up to 3 inches outside diameter. This machine will cut either steel or non-ferrous materials such as aluminum or copper tubing, and can be used with high-speed steel blades for cutting mild steel tubing or with abrasive wheels for cutting high-carbon or hardened rods, tubes, or shapes. It is capable of high production, and will cut pieces to length within limits of plus or minus 0.005 inch. A patented air-operated cam-action chuck holds the tube or rod in position for sawing.

The spindle is driven directly from the motor by multiple V-belts with provision for adjusting the belt length. The shaft that supports the swinging carriage is mounted in ball bearings to provide sensitive control over the saw movement. The travel of the carriage is controlled by stops which are adjustable for tubing of different diameters. When burr-free cuts are required, it is necessary to operate the saw at lower speeds and equip the machine with accessories that will flood the saw blade and work with coolant. Either a 5- or a 7-H.P. motor is supplied as standard equipment, depending upon the kind of cutting to be done.



Semi-automatic Cut-off Machine Built by Pines Engineering Co.



Fitchburg Triple-head Machine for Grinding Gun Barrels and Spindles

To obtain additional information on equipment described on this page, see lower part of page 212.

When extremely high production is desired on comparatively short-length pieces, the machine can be equipped with a separate automatic drive for oscillating the saw. This drive imparts a harmonic motion to the saw carriage which produces a slow speed through the wall of the tube on each side, the speed increasing as the saw passes through the center of the tube. It also provides a quick-return motion for the saw, the stroke of which is adjustable for different work diameters. The drive is equipped with a variable-speed unit giving a range of cutting speeds of from 5 to 30 strokes per minute. 54

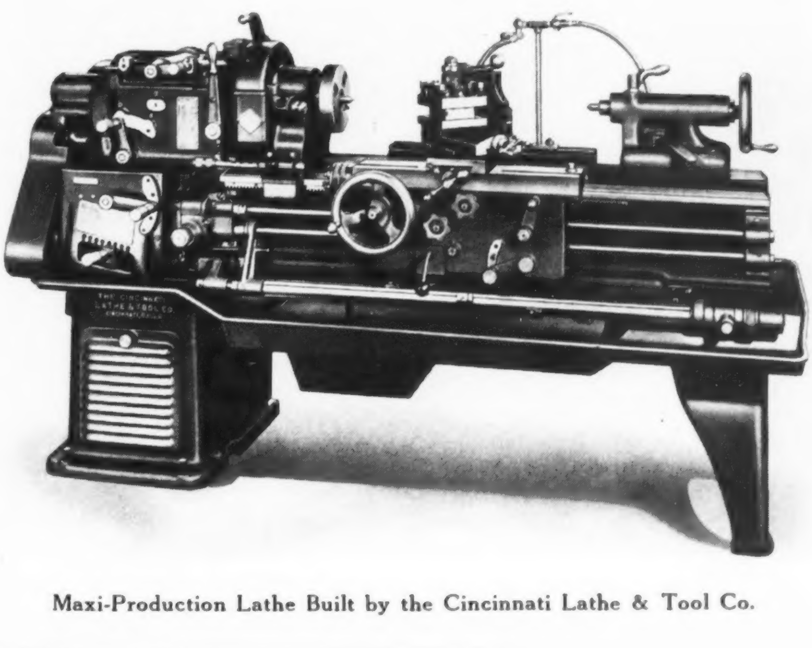
Cincinnati Geared-Head Maxi-Production Lathes

The latest geared-head Maxi-Production lathes built by the Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati, Ohio, are available in eight different sizes ranging from 14 to 30 inches, and in bed lengths varying by 2-foot increments from 6 feet up. These lathes can be supplied with a variety of standard and special attachments.

The thirty-two changes of thread and feed, together with the twelve spindle speeds available on these lathes, are designed to cover nearly every practical machine shop requirement. Provision is made, however, for obtaining sixty-four additional changes of thread and feed and twelve more spindle speeds.

Among the recently developed attachments available on these new lathes is the multiple-length automatic feed-stop. This stop is equipped with six adjustable-length stops which are automatically indexed into position by a trip-lever mounted in the apron. The stop can also be set to any of the six positions by raising a locking pin and turning the index control to the desired setting. The adjustable stop-dogs can be set within 1/8 inch of each other, and will stop the feed to the carriage within 0.002 inch.

A compound and adjustable rear rest designed to take the standard toolpost, the heavy-duty two-screw toolpost, or the Style O four-way turret is another improved unit now available. A six-position multiple carriage stop, when used with a spacing rod, provides as many settings as may be required. Combining this with the six-position stop-bolts gives forty-two possible settings. Each of the six stop-bolts can be adjusted over a length of 2 inches. The usual procedure is to feed the carriage by power to within 0.010 inch of the stop, and feed it the remaining distance by hand. This unit enables duplicate parts to be finished to size to within 0.001 inch. Four-way turrets in various styles and a six-way hexagon turret can also be supplied to meet a wide range of production requirements. 55



Maxi-Production Lathe Built by the Cincinnati Lathe & Tool Co.

Barnes Cutter-grinding Machine with Wheel-truing Devices and Cutter-holding Fixture

Barnes Improved Cutter-Grinding Machine

The Barnes No. 78 improved precision cutter-grinding machine recently placed on the market by the General Machinery Corporation, 140 Federal St., Boston, Mass., is especially adapted for cutter and tool grinding in plants engaged in the manufacture of rifles, pistols, and small precision parts requiring accurate profile milling, hole reaming, etc. This new machine permits accurate and rapid grinding of single plain or formed cutters, gangs of plain or formed cutters, shank cutters, irregular formed cutters, and plain or tapered reamers, no particular skill being required for this work.

The machine thus makes it possible to use profile formed cutters in place of form relieved cutters when desirable. Form relieved cutters, when sharpened on this machine, however, actually become profile cutters, which, in most instances, are claimed to show improvements in both the quality and quantity of work produced. The precision grinding wheel is adjustable forward or backward to meet any grinding requirement. The grinding wheel is driven by a round endless belt from a 1/6-H.P. motor in the base, and can be

To obtain additional information on equipment described on this page, see lower part of page 212.

moved forward by screw adjustments to compensate for wear.

A former pin projecting from the surface of the table provides a rest for the cutter tooth. The height of the rest is fixed at a definite distance below the center of the wheel to give the tooth a standard clearance angle. Each grinder has two diamond truing dressers which slide on the table, one for truing the grinding wheel surface and the other for truing the sides. The dressers are provided with a V-groove to facilitate engagement of the former pin.

The diamond dresser is placed against the former pin and turned to trim the edge of the wheel to the exact shape of the pin. Any part of the periphery of the wheel level with the top of the rest is trimmed to an exact vertical alignment with the templet guiding surface of the pin. Underneath the horizontal cutter-arbor of the jig there is a templet, the front edge of which conforms to the shape of the cutter or gang of cutters to be ground. Contact of this templet with the former pin results in grinding the cutters to the required shape.

For ordinary work, the former pin is provided with a bearing sleeve 3/8 inch in diameter. It will, therefore, grind convex profiles of any radius, and concave profiles, the radii of which are not smaller than 3/16 inch. For sharp internal angles and for concave profiles of smaller radii down to 0.010 inch or less, a special "small radius" former pin sleeve is provided. 56

Watson-Stillman 125-Ton Straightening Press

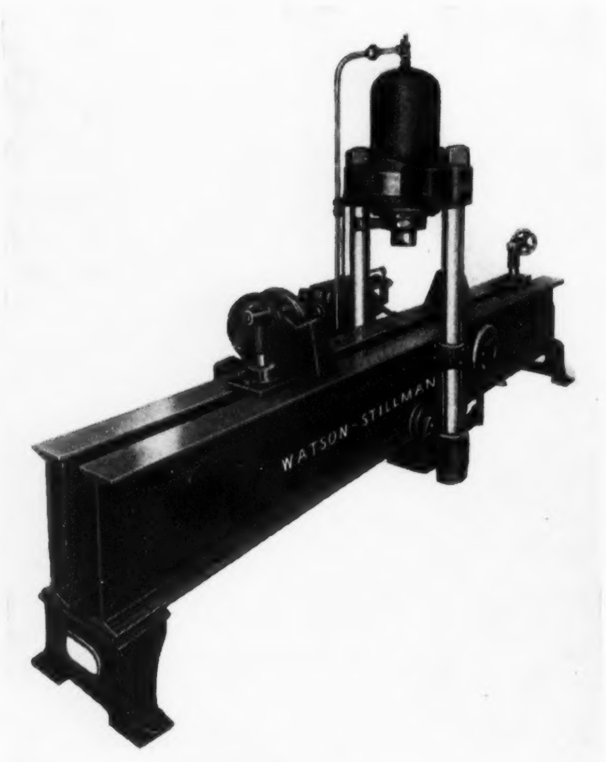
An improved 125-ton straightening press embodying extremely sensitive control by a single hand-lever has been developed by the Watson-Stillman Co., Roselle, N. J., for straightening gun barrels, shafting, forgings, etc. The space between columns is 18 inches; vertical opening, 17 7/8 inches; and stroke, 10 inches. The unit is of the manually movable press type, a handwheel controlling the movement of the press along the table, which is 14 feet long, 17 inches wide, and equipped with bending blocks, centers, and rollers. The advance speed is 87 inches per minute, pressing speed 13 1/2 inches per minute, and return speed 78 inches per minute.

The entire unit weighs approximately 7500 pounds, is 10 feet high, and requires a floor space of 14 by 5 feet. It is operated by a radial pump with servo-motor control which delivers 36 gallons per minute at a pressure of 200 pounds per square inch, and 5.5 gallons per minute at 2650 pounds per square inch. 57

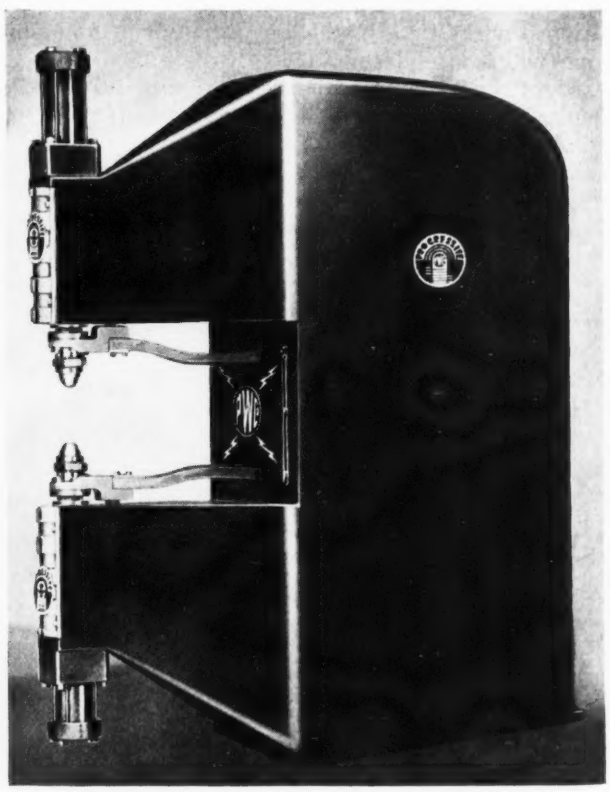
"Temp-A-Trol" Forge Welder with Automatically Controlled Welding Cycles

A welder in which the temperature at the weld itself automatically controls the welding, heat-treating current, and operating cycle, and which is completely self-compensating for all such variations as normal difference in metal thickness, induction and short-circuiting losses, presence of scale, etc., has been brought out by the Progressive Welder Co., 3050 E. Outer Drive, Detroit, Mich.

This new "Temp-A-Trol" forge welder spot-welds, and then heat-treats the weld. Close control of the weld nugget size, ductility, and



Watson-Stillman 125-ton Straightening Press with Sensitive Control



"Temp-A-Trol" Forge Welder with Automatic Control Built by Progressive Welder Co.

To obtain additional information on equipment described on this page, see lower part of page 212.

grain refinement is thus obtained. It is claimed that this welder also avoids annealing of hardened surfaces in the work. The welder is especially designed for the resistance welding of heavy sections and of special alloy steels, such as face-hardened armor plate. 58

Snyder Semi-Automatic Machine for Milling Clearances in Radial Engine Master Rods

Clearances for articulated connecting-rods can be rough- and finish-milled in the master rods used in radial aircraft engines on a new semi-automatic milling machine designed and built by the Snyder Tool & Engineering Co., 3400 E. Lafayette St., Detroit, Mich. This machine will handle either solid or split type rods. Since the cutting cycle of the machine is automatic, being hydraulically operated and electrically controlled, one unskilled operator can keep several of these machines in continuous production.

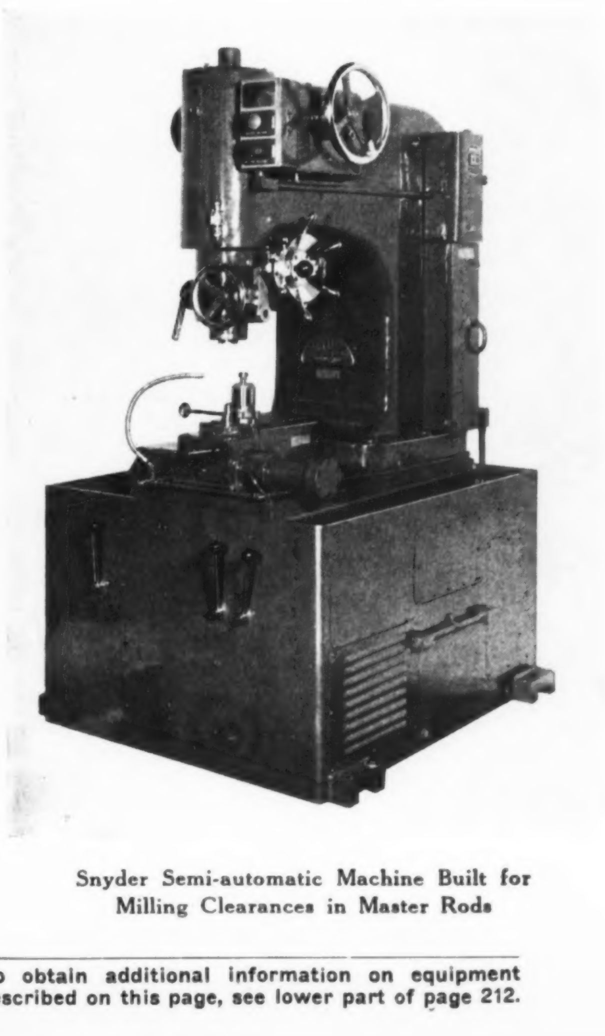
The main bore of the master rod is located on a plug, and a bored and reamed hole for the articulated rod is positioned on an eccentric bushing. The part is then hydraulically clamped by means of a clamping bolt and a C-washer over the hub. The cutting tool is rotated by a vertically adjustable quill type spindle, which is driven by a worm-wheel. A pilot light indicates the completion of the machining cycle, at which time the operator indexes the part for the next cutting cycle without unclamping the work. 59

Micron Spur and Helical Gear Hobber

A new Model No. 1 American Micron hobbing machine is being placed on the market by the Triplex Machine Tool Co., 125 Barclay St., New York City. This gear-hobber is larger than previous machines of this model. It is built in the shops of the Hamilton Tool Co., and is designed to generate accurate spur and helical pinions and gears, of either right- or left-hand helix, up to 6 inches in diameter, with a maximum diametral pitch of 12. The gears produced are used in small precision machines, instruments, meters of all kinds, clocks, and mechanisms requiring gears of similar accuracy.

The length of the automatic traverse of the carriage is 5 inches. The power feed is actuated by a lead-screw in the base. The lead-screw is driven by the work-rotating spindle through four feed-change gears. Nine feeds ranging from 0.002 to 0.033 inch per revolution of the work are available through the use of a standard set of feed-change gears furnished with the machine. Four different hob speeds ranging from 280 to 950 R.P.M. are available. The hob is brought into cutting position by elevating the swivel base of the headstock. This is done by turning a handwheel at the front of the machine. The correct position is maintained by a clamp. The sleeve in the elevating handwheel is graduated to 0.001 inch.

Standard equipment of each machine includes a set of three change-gears for producing gears with one definite number of teeth. Change-



Snyder Semi-automatic Machine Built for Milling Clearances in Master Rods

Micron Spur and Helical Gear Hobber Placed on the Market by the Triplex Machine Tool Co.

To obtain additional information on equipment described on this page, see lower part of page 212.

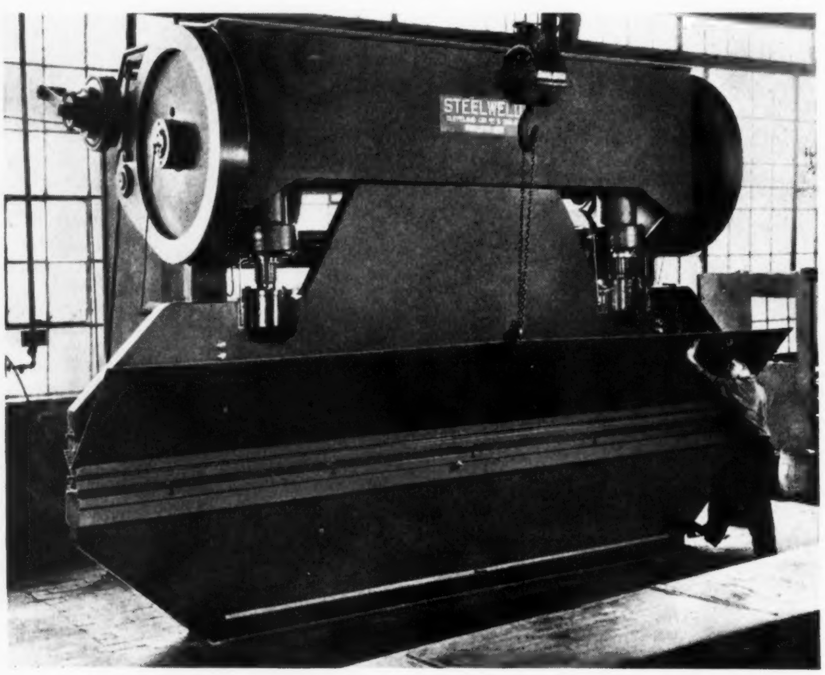
gears for other numbers of teeth can be furnished as extra equipment. Any number of teeth between 6 and 130 can be hobbed on this machine. Also, any even number of teeth between 130 and 260 can be obtained. Any number of teeth between 260 and 325 that is divisible by 5 can be hobbed.

The differential mechanism is used only when hobbing helical gear teeth, this mechanism being locked out of action when hobbing spur gears. A set of four change-gears is required for each helix angle. Only one set of helical change-gears is furnished as standard equipment with the machine, but additional sets can be obtained as extra equipment. A 1-H.P. motor mounted inside the pedestal drives the machine through a two-step belt drive in which provision is made for adjusting the belt. 60

Steelweld Two-Speed Bending Press

The Steelweld Machinery Division of the Cleveland Crane & Engineering Co., 1157 E. 283rd St., Wickliffe, Ohio, has recently added a Model L5 1/2-12 machine to its line of Steelweld bending presses. This new press has a double bed and ram extension for bending and forming plate up to 20 feet in width. It is similar in appearance to the Model H-8 press described in June, 1940, MACHINERY, page 157, but has several new features which include two-speed gearing with safety built-in clutch to permit operation at either seven or twenty-one strokes per minute; a hand-wheel-operated gear-shifter; and a tonnage indicator, which indicates the loadings to which the press is subjected. This indicator registers the tonnage for any job being performed, and also shows the highest tonnage at which the press has ever operated.

The illustration shows the press engaged in bending a 20-foot plate, 5/16 inch thick. The same machine will bend 1/2-inch plate in widths up to 12 feet, and even heavier plate in narrow widths. In addition to bending, this press can also be used for forming, blanking, drawing, and multiple punching operations. Like all presses in the Steelweld line, the frame is of one-piece all-welded steel construction. All gearing is protected by metal enclosing covers. The ram is operated by two forged-steel gear eccentrics, one on each end of the machine. Each eccentric has three large main bearings and an eccentric bearing. The bearings are automatically lubricated by two pressure type oiling units. 61



Steelweld Bending Press with Two-speed Gearing and Safety Built-in Clutch

Tap Reconditioner Made by the Detroit Tap & Tool Co.

Detroit Tap Reconditioner

A tap reconditioner designed to assist in overcoming the difficulties experienced in meeting the existing demand for large numbers of precision-ground taps has been announced to the trade by the Detroit Tap & Tool Co., 8432 Butler St., Detroit, Mich. This machine combines in one unit the facilities for chamfering, spiral pointing, and point polishing taps.

The tap chamfering unit, located at the left of the machine, is of the precision collet type, arranged to assure maximum locating accuracy. The machine is designed to accommodate collets with capacities from the smallest machine screw size up to 1 1/4 inches in the standard tap shank size. Taps with from two to seven flutes can be handled through the provision of an indexing drum, the indexing being done by a dual-purpose lever which releases the spring plunger.

The spiral pointing unit, at the right-hand side of the machine, employs a saucer type wheel and will accommodate taps from the smallest machine screw size up to 1/2 inch in diameter. Any desired angle of spiral point can be ground by setting the unit to graduations on the support housing. Taps of two, three, or four flutes can be spiral-pointed. Indexing of the tap is accomplished by pulling back the trigger, which rotates the fixture, to bring the next flute into the proper grinding position. 62

To obtain additional information on equipment described on this page, see lower part of page 212.

Baush Hydraulic Horizontal Boring Machine

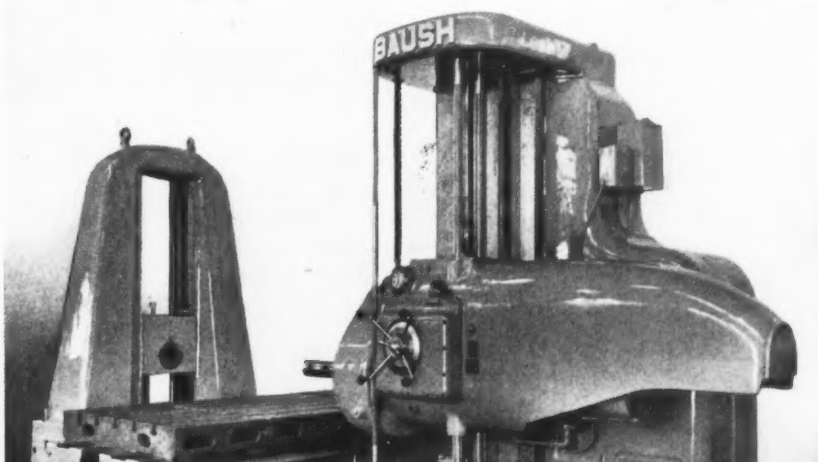
A horizontal boring machine with hydraulic feed for the table, cross-heads, and boring-bar is being built by the Baush Machine Tool Co., Springfield, Mass. The base of this machine has hand-scraped ways, 60 inches wide, and carries a table 48 by 96 inches. The cross-travel range is 72 inches, and the longitudinal travel 48 inches when using the rear support, and 72 inches without the support.

The pumps, fluid motors, and tank of the hydraulic system are contained in the base. The hydraulic pumps, valves, and fluid motors are mounted above the tank, so that any possible leakage from the hydraulic system will be caught by the tank. Two pumps and fluid motors are employed at the same time to obtain different rates of travel. The motions from each pump are as follows: The first pump controls the individually operated longitudinal travel of the table and the vertical motion of the cross-heads, while the second pump controls the individually operated cross-feed of the table and the boring-bar. These motors provide rapid traverse and feed in either direction.

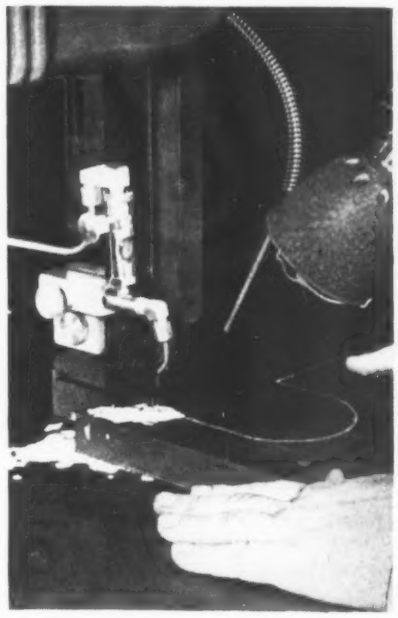
The hydraulic controls are mounted at the top and front of the base, while the rapid traverse and the feed in both directions are controlled with one lever for each pump. The large knob in the center of the feed-lever mechanism is used for selecting the rate of feed, and can be adjusted while the machine is in operation. The rapid traverse of all motions in both directions is 50 inches per minute, while the feed is variable from 1/2 to 9 inches per minute. A hand-feed for fine setting of all motions is provided.

The boring-bar is driven by a 15-H.P., direct-current motor operating in sequence with an alternating-current motor-generator set that gives the bar an infinite number of speeds within a range of 8 to 800 R.P.M. A lower range of speeds is obtainable from 8 R.P.M. downward. The motor and the drive mechanism are protected from overloads by an easily replaceable shear pin. A speed indicator mounted on the cross-head indicates the R.P.M. of the bar when running in either direction.

The cross-head is equipped with a faceplate 18 inches in diameter with T-slots and a center plug for mounting and centering large milling cutters. The quill is approximately 40 inches long, and has a tapered take-up for the bar at each end. 63



Horizontal Boring Machine with Hydraulic Feeds
Built by Baush Machine Tool Co.



Lubricator for DoAll Band Saw
Made by Continental Machines

DoAll Band-Saw Lubricator

A lubricator designed to increase the life of DoAll metal-cutting band saws has just been announced to the trade by Continental Machines, Inc., 1312 S. Washington Ave., Minneapolis, Minn. It is claimed that straighter cuts can be taken and a finer finish obtained when this lubricator is employed.

The lubricator is attached directly to the post above the saw guide, as shown in the illustration. The flexible feed-line can be adjusted to direct the coolant properly. Since the amount of coolant required is small, the attachment is provided with a feed control valve which enables the operator to regulate the amount of coolant fed to the work. The coolant thus fed to the saw and work performs two functions. On steel and other metals having a relatively high tensile strength, it prevents the saw teeth from becoming heated as they pass through the work. In sawing thick sections, this heating has been found in some cases to actually anneal the fine points of the teeth, causing them to break down rapidly and thus dulling the saw. Applying coolant to the kerf of the cut prevents this trouble.

On metals having a relatively low tensile strength—such as aluminum, copper, leaded brass, zinc, etc. — the coolant adequately prevents building up of the metal on

To obtain additional information on equipment described on this page, see lower part of page 212.

the saw or on the sides of the material. This build-up usually results from chips that are compressed between the sides of the saw and the walls of the saw kerf, causing wear on the saw. 64

Paragon Blueprinting Equipment

A new continuous type blueprinting or copying machine has just been developed by the Paragon-Revolute Corporation, 77 South Ave., Rochester, N. Y., for making contact prints on subdued-light type photographic materials. This machine is known as the Revolute 8F continuous copier. It is designed to make reproductions rapidly from any type of original up to 44 inches in width by any length. Reproduced tracings can be made from blueprints or black and white or colored originals. Copies can be made of originals which are on either transparent or opaque materials.

This new copier is designed to prevent slippage between the copy and print and to eliminate blurred prints. The original drawing or copy and the sensitized print material revolve with a pyrex glass cylinder 8 inches in diameter. On the inside of the glass cylinder are three fluorescent lamps, usually two white and one gold lamp. The white lamps are used for making reproductions from black and white originals, while the gold lamp is employed for making reproductions from blueprints.

Transparencies printed on one side only are reproduced by transmitting light through them onto a sensitized material. Opaque originals which are printed on two sides are copied by reflecting or "bouncing" light back onto the sensitized material.

These new photographic materials do not have to be handled in special dark rooms. No focussing is necessary, and no lenses are required. Negatives on this new material are claimed to be superior to those made on the papers previously available because of the opaqueness of the background. It is also claimed that these materials will make better reproductions from soiled originals or from originals that contain pencil or other fine lines ordinarily lost in the printing process. 65

Watson-Stillman 1000-Ton Straightening Press

A giant press capable of exerting a 1000-ton squeeze, which enables one man standing at a central control panel to straighten shafts up to 18 inches in diameter, has been built by the Watson-Stillman Co., Roselle, N. J., for the Penn Forge Co. This press has a capacity for straightening shafts from 12 to 18 inches in diameter and from 7 to 60 feet in length.

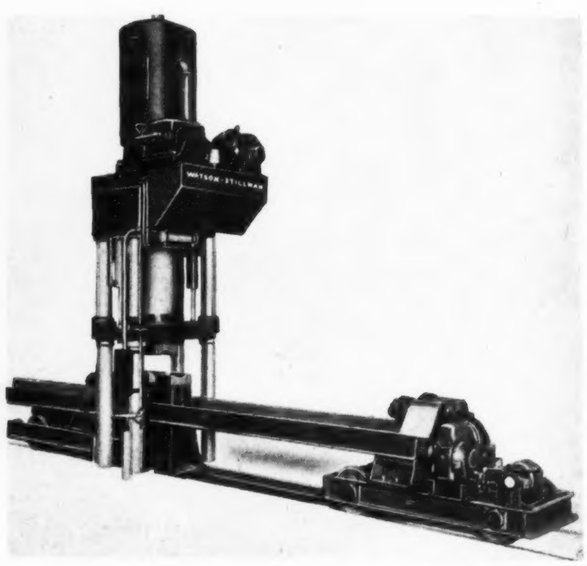
There are two sets of rollers for handling and positioning the work. Each set of rollers is mounted on a hydraulic lifting ram, which, in turn, is supported on a motor-driven carriage running on rails between the columns of the press. One set of rollers is provided with a motor drive for rotating the work as required. When the work is properly positioned, the rams under the rollers lower it onto two bending blocks. Each bending block is independently motor-driven for separation or space adjustment within a range of from 2 feet 3 inches to 18 feet.

Pressing speeds are 470 inches per minute for the advance and return movements and 15 1/2 inches per minute for pressing. The stroke is 38 inches, the opening 48 inches, and the space between columns 48 inches. The rotary-piston oil type press pump is driven by a 50-H.P. motor. The press requires a floor space 8 by 24 feet, and is 28 feet high over all, the height above the floor being 21 feet. 66

Lathe Steadyrest and Drill-Centering Attachment for Toolpost

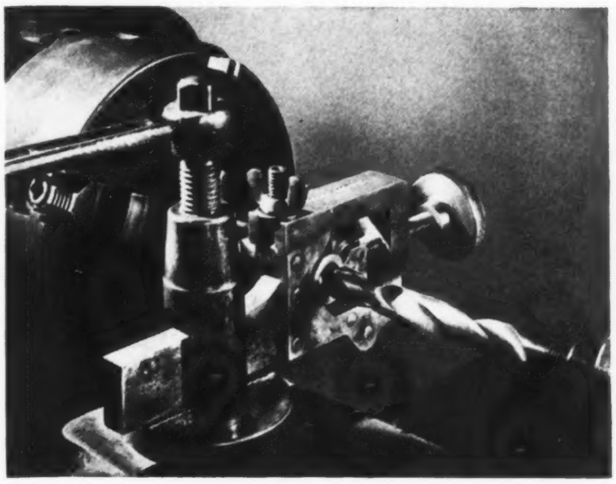
A new steadyrest and drill-centering attachment for toolpost mounting, designed to serve as a

Continuous Type Blueprinting Machine Brought out by the Paragon-Revolute Corporation

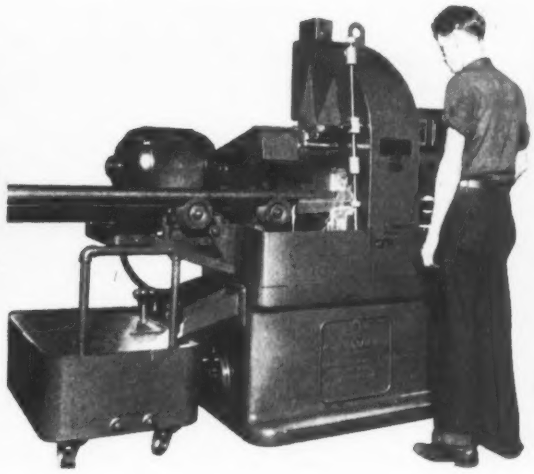


Watson-Stillman Press for Straightening Shafts up to 18 Inches in Diameter by 60 Feet Long

To obtain additional information on equipment described on this page, see lower part of page 212.



Nielson Lathe Steadyrest and Drill-centering Attachment for Toolpost



"Cutalator" Wet Abrasive Cutting-off Machine with Hydraulic Feed

convenient, time-saving device for lathe operators, has been patented and placed on the market by P. W. G. Nielson, 1360 Seminole Drive, Greensboro, N. C. The device can be quickly adjusted and locked in position in the regular toolpost.

By inserting a standard drill jig bushing between the jaws, the attachment can be used as a drill jig for drilling or reaming a cored hole or for steadying a drill for centering operations. 67

Sequence Timer for Resistance Welding

For use in automatic resistance spot, butt, or projection welding, a new weld and sequence timer has been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This unit — which is about 17 inches high, 12 inches wide, and 12 inches deep, with an approximate weight of 60 pounds — is housed in a steel-wall enclosure, on the front panel of which are the individual timing circuit, adjusting potentiometer knobs and dials, the repeat and non-repeat switches, and the tubes.

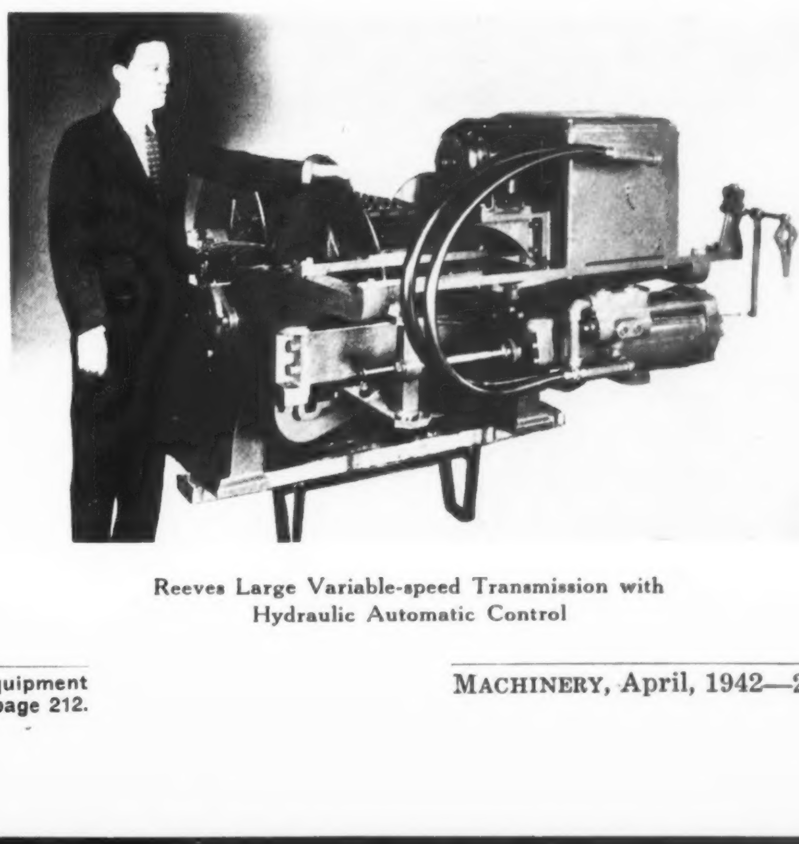
The timer divides the total time of the weld into the various intervals in which the welding machine goes through its operating cycle, and includes a "weld" period of from three to thirty cycles when the full welding current flows. For welding thick plates, brass, or stainless steel, the timing arrangement permits intermittent heating and cooling steps of from three to thirty cycles. 68

Campbell Wet Abrasive Cutting Machine

A wet abrasive cutting machine known as the No. 425 "Cutalator," which is especially designed for fast, high-quality cutting of practically all kinds of materials up to 3 1/2 inches in diameter in solid stock and up to 4 1/2 inches in diameter in tubing, has been brought out by the Andrew C. Campbell Division, American Chain & Cable Co., Inc., Bridgeport, Conn. The combination oscillating and rotating movement of the hydraulically fed abrasive cutting wheel results in a short arc of contact between the wheel and work. Hydraulically operated clamps and V-type supports hold the work securely. A micrometer work-stop facilitates rapid and accurate setting up. 69

Reeves Large Variable-Speed Transmission with Hydraulic Automatic Control

A variable-speed transmission, believed to be the largest ever equipped with hydraulic automatic control, was built recently by the Reeves Pulley Co., Columbus, Ind. This transmission, weighing 4300 pounds, is nearly 9 feet long, 5 feet wide, and 4 feet high. It transmits 26 H.P. at maximum speed and provides for an infinitely variable



Reeves Large Variable-speed Transmission with Hydraulic Automatic Control

To obtain additional information on equipment described on this page, see lower part of page 212.

range of speeds covering a ratio of 3 to 1.

The hydraulic control provides complete automatic speed variation of the transmission. The purpose of this particular installation, which is used on a rotary veneer lathe, is to maintain a uniformly high peripheral cutting speed on the log at its full original diameter down to the smallest diameter at the end of the cut. 70

General Electric Tri-Clad Motors

Three new motors — a vertical general-purpose polyphase motor, a vertical shielded polyphase motor made in sizes from 1 to 20 H.P., and a vertical shielded single-phase motor made in sizes from 1 to 5 H.P.—have been added to the Tri-Clad line made by the General Electric Co., Schenectady, N. Y. The shielded type motors are especially suited for pumping applications. The general-purpose motor is adapted for use in the machine tool industry, and for driving mixers and similar equipment.

All openings in the general-purpose motor are shielded to prevent the entrance of chips or other falling objects. This motor is available with a variety of bases designed to meet the requirements of a wide range of applications. The polyphase shielded type motors are available in either solid-shaft construction or hollow-shaft construction, while the single-phase shielded type motors are available only in the solid-shaft construction. Both shielded types are designed for normal-thrust or high-thrust applications.

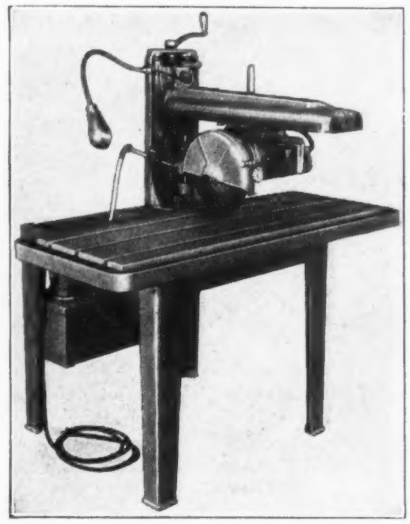
These motors are suitable for outdoor operation, except where extremes of moisture, dust, or other harmful agents make the selection of fan-cooled motors more economical. All frame sizes have common mounting dimensions, making possible interchangeability of many horsepower and speed combinations, including single-phase ratings. The motors can be rotated to any one of four base positions without modification of the supporting structure. 71

Wallace Metal-Cutting Saw

The No. 1-M metal-cutting saw built by J. D. Wallace & Co., 149 S. California Ave., Chicago, Ill., is now being furnished with a new cast-iron T-slot table assembly, designed for holding materials of irregular shapes or mounting a fixture in any desired position. The motor unit and blade or abrasive wheel of the machine slides back and forth on a radial arm.

The machine handles cut-off work on hard and soft steel, angle-iron, brass, bronze, duralumin and aluminum, glass, plastics, and other materials. Other models of the radial type saw are available for sawing or shaping wood in the shipping room or for general plant maintenance work.

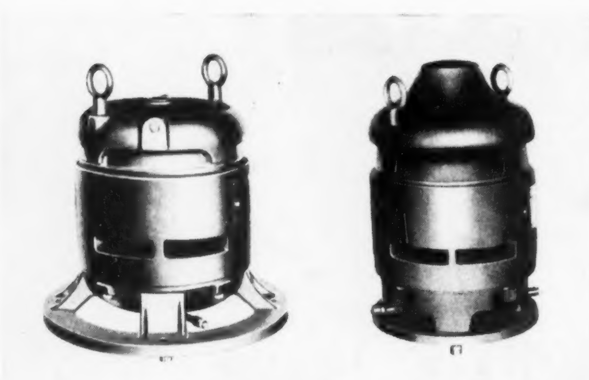
The column, arm, and motor all rotate 360 degrees, and can be locked in any position for simple or compound angle work or for ripping operations. The stock is held stationary while the motor unit is pushed or pulled in taking a cut. Material up to 4 inches in depth can be cut, using motors up to 2 H.P. in either single- or three-phase ratings. Either saw blades or abrasive wheels 3/32 inch thick are used for cutting, depending on the material handled. Bars, sheets, extruded sections, metal moldings, tubings, casting sprues, and many other shapes and forms of material can be handled. 72



Metal-cutting Saw Built by J. D. Wallace & Co.

Truscon Corrugated Steel Box for Handling Forgings and Small Parts

A corrugated steel box and platform unit with a hinged end door, designed for handling either hot or cold small forgings and other metal parts, has been developed by the Pressed Steel Division of the Truscon Steel Co., Youngstown, Ohio, a subsidiary of the Republic Steel Corporation. The bottom of the box is smooth and of heavy gage steel. When placed on a rack and tilted to an angle of approximately 20 degrees, the parts will flow



"Tri-Clad" Vertical Type Motors—General-purpose at Left and Shielded Type at Right

Truscon Steel Box and Platform for Handling Small Forgings and Other Metal Parts

To obtain additional information on equipment described on this page, see lower part of page 212.

easily through the door opening onto a table or other convenient place for the worker. A slotted bar permits holding the door open as required to control the flow of material from the box. This unit can be used with forked trucks, and can be equipped with tiering or crane lugs for efficient storage and handling. 73

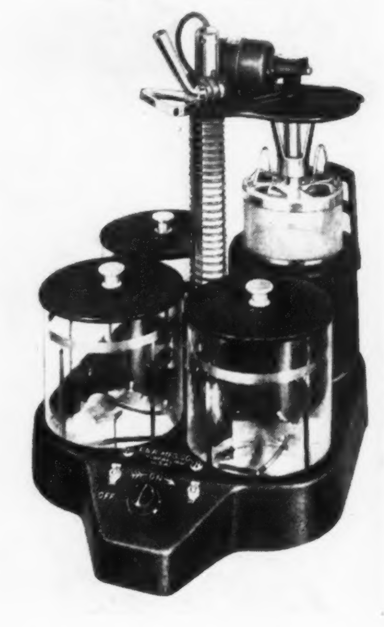
Federal Shell Inspection Gages

Shell inspection gages of improved design for simultaneously checking any desired number of surfaces for size and concentricity have just been brought out by the Federal Products Corporation, 1144 Eddy St., Providence, R. I. The shell or projectile to be inspected is located in a V-block faced with tungsten carbide at the contact points to resist wear. With this arrangement, the smaller size shells can be rotated manually with comparative ease for the quick checking of size and concentricity of several surfaces simultaneously.

The Model 205 B-84 gage shown in Fig. 1 is arranged for checking the concentricity of the tracer or fuse holes, rotating band, bourrelet, and ogive diameters of shells. This gage is typical of the new dial-indicator equipped gages furnished to check concentricity of shell or projectile diameters of practically any size. It is frequently used in combination with the Model 236 B-95 gage shown in Fig. 2, which is equipped for checking the diameters of shells and projectiles. The two gages are similar in construction, but arranged to meet the requirements of Government specifications applying to concentricity and diameters.

Each indicator has a pantograph spring unit, which protects it from abuse and, at the same time, contributes to the accuracy and furnishes an adjustment for proper contact with the shell. The pantograph unit has an adjustable guard which prevents damage to the pantograph point. The particular gage shown in Fig. 1 is also equipped with a sliding indicator and pantograph unit which contacts the fuse hole or tracer cavity for inspecting its concentricity with the outside diameter. A stop is provided to locate the contact point at the desired position in the cavity or fuse hole.

The gage shown in Fig. 2 is designed to check four diameters independently of each other and simultaneously. The effect is the same as if four operators checked these four diameters with four individual single-purpose gages. This gage can also be built to check either a larger or a smaller number of diameters. 74



L & R Machine for Cleaning Aircraft Instruments

L & R Industrial Cleaning Machines

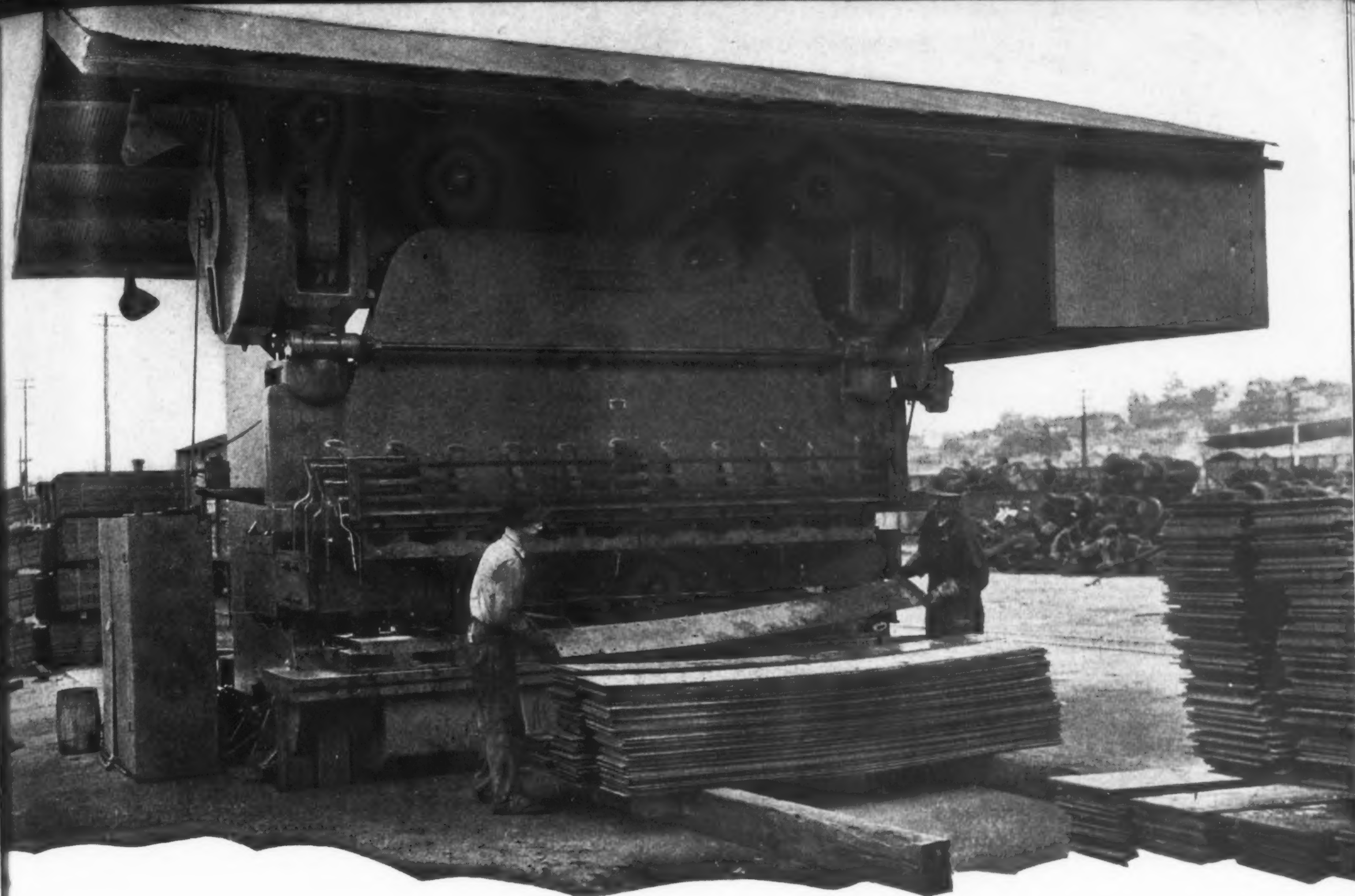
Machines and cleaning solutions for the rapid cleaning of parts such as aircraft instruments, have been developed by the L & R Mfg. Co., 54-56 Clinton St., Newark, N. J. The new machines are similar to the smaller watch-cleaning machines built by this company for many years. The machines, as well as the cleaning and rinsing solutions, are being used for cleaning a great variety of small parts and instruments—fire-alarm mechanisms, ball bearings, gages, parking meters, and clocks, in addition to aircraft instruments.

The disassembled parts, or whole units, are placed in the work basket, which is then snapped into position on the motor shaft. The center bar on which the motor is mounted positions the basket properly over each solution jar and the drying chamber. The basket is first lowered into the cleaning solution jar which contains L & R "Power Nofome"—a non-foaming cleanser. Monel metal baffles within the jars, together with a unique design of the carrying shaft, assure thorough

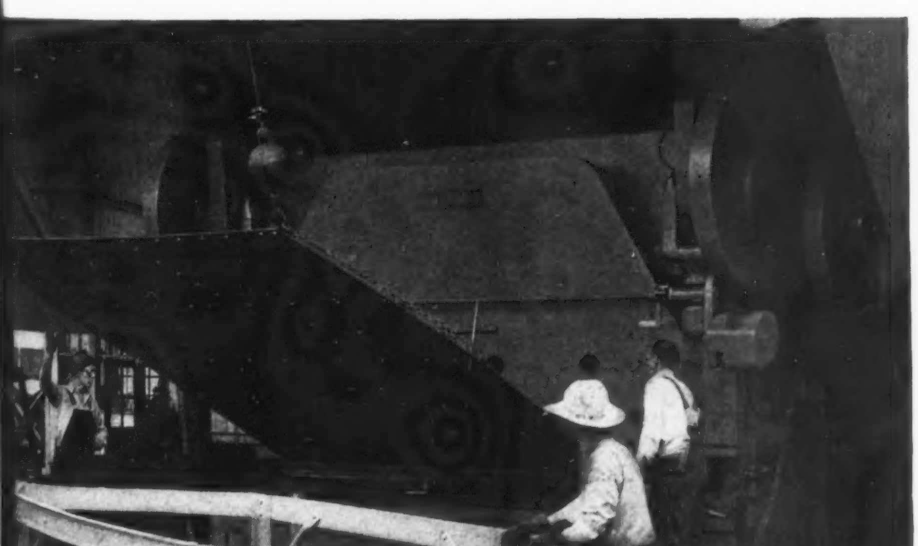
Fig. 1. Federal Shell Concentricity Gage

Fig. 2. Gage for Checking Shell Diameters

To obtain additional information on equipment described on this page, see lower part of page 212.



Paid For Itself In Four Months



ON one job alone, required for the rebuilding of 1800 hopper cars, the above recently installed 400 series Cincinnati All-Steel Press Brake completely refunded the investment in four months.

• • • • •

At the left is another CINCINNATI PRESS BRAKE working for a railroad. Job illustrated—bending end on hopper chute. Records show that this unit has refunded the investment at least four times during its 3 years of service.

Every plan for modernization or new car construction should include the economies which can be effected with Cincinnati All-Steel Press Brakes.

Write for recommendations on your job.

THE CINCINNATI SHAPER COMPANY, CINCINNATI, OHIO

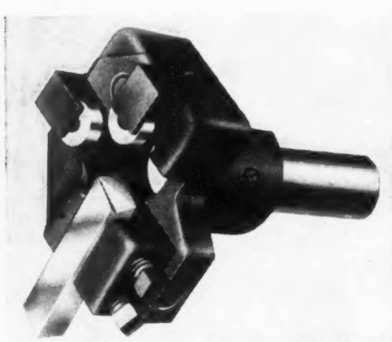
agitation of the solutions. After running in the "Power Nofome" solution, the motor is stopped and the basket raised above the liquid level in the jar, and again rotated to throw off excess solution, the jars being of sufficient height to receive the fluid thrown off.

These operations are then repeated in the second and third jars, which contain the L & R rinsing solution. Next, the motor carrier is revolved to the fourth position, which places the work basket over the drying chamber. This chamber has a separate motor and fan, together with a vitreous heater unit. The heater switch is turned on at the beginning of each cleaning job to insure maximum heat for the last operation. About two or three minutes is required for each phase of the cycle, depending on the type of instrument cleaned and the condition of the parts.

The work basket is made entirely of Monel and Monel mesh. It has an inside diameter of 5 1/2 inches and a depth of 3 3/8 inches. The jars have a capacity of 1 1/2 gallons, with an inside diameter of 7 inches and a depth of 9 inches. The machine, with the solutions, weighs 41 1/2 pounds and occupies a space 17 1/4 by 16 1/2 by 23 inches high. 75

Boyar-Schultz Box-Tools for Screw Machines

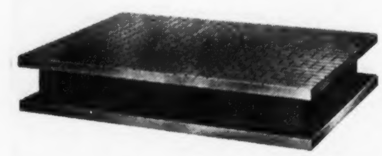
The Boyar-Schultz Corporation, Walnut St. at Hoyne-C, Chicago, Ill., has just brought out a box-tool for use on hand and automatic screw machines. This tool is made in three sizes. The 00 size has a capacity for turning work from 3/32 to 3/8 inch in diameter by 1 5/16 inches long; the 0 size turns work from 3/16 to 5/8 inch in diameter by 1 23/32 inches long; and the 2 size tool will turn work from 1/4 to 7/8 inch in diameter by 2 15/32 inches long. The body of this tool is made from a heat-treated alloy steel forging. 76



Boyar-Schultz Box-tool for Screw Machines

Challenge Bench Blocks

Bench blocks known as the "Challenge Duplex" have been designed by the Challenge Machinery Co., Grand Haven, Mich., to serve two purposes. These blocks have working surfaces on both top and bottom, and are available in three styles—with one surface smooth and the other grooved in 1/2-inch widths for lapping metal-to-metal joints; with both sides smooth, in which case one surface can be used for working purposes and the other held in reserve for lay-out, assembly, and inspection; and with both surfaces grooved in 1/2-inch mesh for lapping.

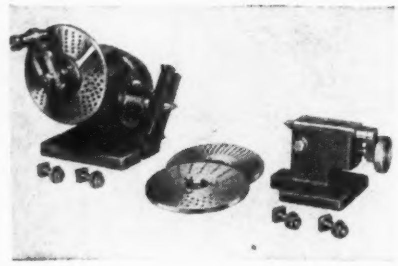


"Challenge Duplex" Bench Block with Grooved Surface for Lapping

These blocks are precision-ground both top and bottom in the smooth or grooved surface styles. They can also be supplied with either or both surfaces hand-scraped. The projection of the top and bottom sections provides a convenient ledge for clamping or attaching measuring instruments. Only one stock size is available—10 inches wide, 14 inches long, and 2 3/8 inches high. The material is a special analysis semi-steel. The blocks are ribbed internally to insure rigidity and strength, and are specially heat-treated to relieve strains. 77

Vernon Universal Index-Centers

The new Vernon universal index-centers brought out by the Machinery Mfg. Co., 1915 E. 51st St., Vernon, Los Angeles, Calif., have been designed to permit maximum distance between centers when used on the Vernon No. 0 milling machines or other machines of a corresponding size. The index-plates furnished as standard equipment will divide all numbers up to 50 and all even numbers up to 100, with the exception of 96.



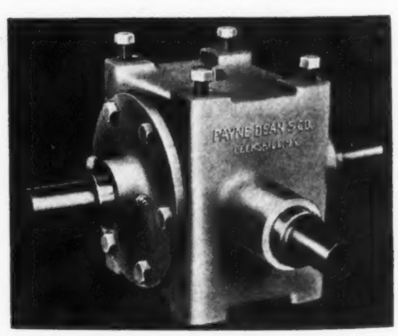
Vernon Universal Index-centers

The head can be set at any angle from 10 degrees below the horizontal to 10 degrees past the perpendicular position by means of a positive clamp. The dial is accurately graduated in degrees. The 40 to 1 ratio worm and worm-gear are accurately cut with provision for take-up in case of wear. The worm is quickly accessible by removing a cover plate.

The spindle taper is No. 9 B & S. The spindle nose has a U. S. Standard right-hand thread, 1 3/4 inches in diameter, eight threads per inch, to take either a chuck or fixture. A take-up nut is provided for eliminating end thrust on the spindle. Standard equipment includes three index-plates with chart, four hold-down bolts, and four table-slot tongues. 78

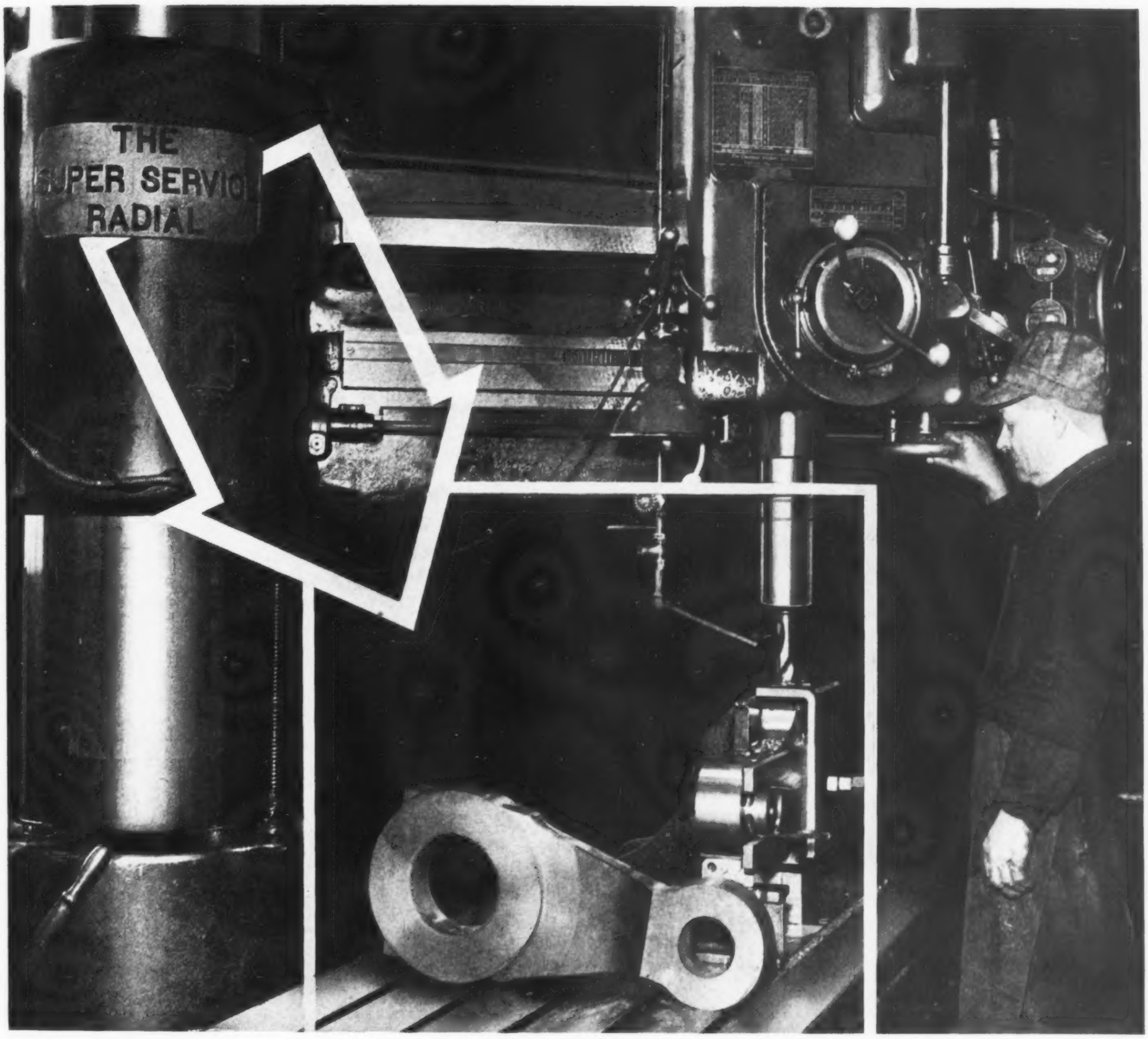
Dean Angle Drive

A miter gear drive with a 1-to-1 ratio for changing the angular position of a driving or driven shaft through an angle of 90 de-



Dean Adjustable-angle Drive for Vertical or Horizontal Mounting

To obtain additional information on equipment described on this page, see lower part of page 212.



Another VITAL Application of the SUPER SERVICE RADIAL...

★

CINCINNATI BICKFORD ENGINEERING SERVICE IN THE INTEREST OF VICTORY

The Cincinnati Bickford Tool Co. is now developing drilling machines that produce victorious results and will continue to hold those high standards for many years to come. The Engineering Staff is not satisfied to rest on laurels that won their Super Service Metal Drilling Machines the slogan of More Holes per Dollar, but they are ever searching for improvements that will continue to keep The Cincinnati Bickford Tool Company's name in that category of one who builds machines that drill MORE HOLES PER HOUR.

RAILROAD PRODUCTION

Drilling to close parallelism is an important operation at the American Locomotive Company Plant. The parts so drilled are eccentric cranks which are to be bolted to main crankpins. Long holes are required; specifications call for drilling these holes closely parallel to the vertical center lines passing through both bearings. The machine used for this precise operation (illustrated above) is the **Cincinnati Bickford Super Service Radial with numerous features to insure consistently accurate performances in the high speed production of numerous vital products needed for America's gigantic Victory output.** Write to Cincinnati Bickford for detailed information on all models of Super Service Radials and Upright Drills.

THE CINCINNATI BICKFORD TOOL CO. OAKLEY, CINCINNATI, OHIO, U. S. A.

grees has been developed by Payne Dean & Co., 22 E. 38th St., New York City. The driving or driven shaft can be arranged to operate in either the horizontal or the vertical position. The drive can be mounted on the floor, wall, or ceiling, the universal base being adapted for any of these positions. By employing universal joints to connect the drive with the driving and driven shafts, almost any angle of drive can be obtained.

The housing is completely oil-tight in any position. The Series ADS drive will transmit 5 H.P. at 600 R.P.M., and the Series ADH will transmit 5 H.P. at 1200 R.P.M. The projecting shafts, which are 1 1/4 inches in diameter, can be made in any length, although 3 inches is standard. Provision is made for 5/16-inch keys. Bronze bearings lubricated by Alemite fittings are used on the low-speed units, and anti-friction ball or roller bearings are employed on the high-speed units. The housing is 6 1/2 by 7 1/2 by 8 1/4 inches high. The complete unit weighs 50 pounds. 79

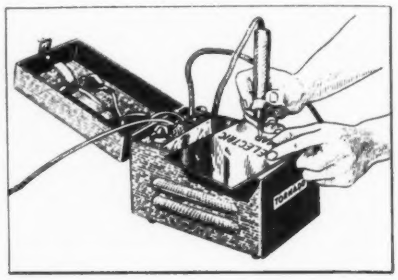
DoAll Supply Cabinet

A supply cabinet for storing saws, files, and other attachments used on DoAll machines is being placed on the market by Continental Machines, Inc., 1312 S. Washington Ave., Minneapolis, Minn. Over 8000 feet of band saw in 100-foot coils can be stored in the twelve bins of this cabinet according to width, pitch, temper, and set. Ample space for saw bands that are in use is also provided.

The DoAll parts box furnished with each machine fits into one of three shelves; the remaining shelves provide space for other attachments. A replaceable illustrated inventory pad is mounted on the left-hand door. This orderly arrangement simplifies keeping the inventory sheet up to date.

All shelves and partitions are fastened by screws, so that adjustments in sizes can be made to suit requirements. The doors contain a three-way lock. The cabinet measures about 16 by 30 by 80 inches, and is furnished in the new machine tool gray color. 80

Supply Cabinet for DoAll Machines

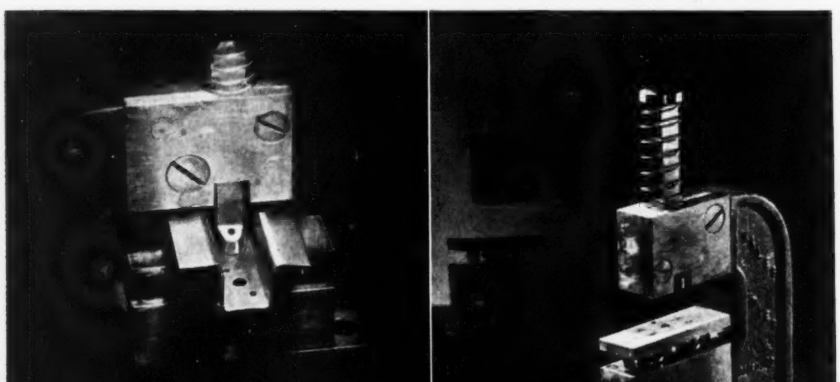


"Tornado" Electric Etcher for Marking Tools and Dies

"Tornado" Electric Etchers

Electric etchers of special design, known as the "Tornado," have been added to the line of equipment made by the Breuer Electric Mfg. Co., 5100 N. Ravenswood Ave., Chicago, Ill. These etchers are available in various models, and are especially adapted for marking dies, tools, and other portable equipment for permanent identification.

They are made for both light and heavy etching on smooth surfaces of steel and iron. The lighter type of etcher is designed for marking tools, gears, saws, etc., while the heavy-duty etcher is adapted for use on large-sized, smooth-surfaced objects, including shovels, crowbars, castings, etc. The etcher is equipped with a red light to indicate when the switch is on. The desired etching heat is obtained by adjusting the switch. Regular equipment includes tools, switch, indicator lamp, and plug-in cords, all of which are contained in a compact portable case. The Model A etcher weighs 16 pounds, and the Model B 29 pounds. 81



Wales Punch and Die Holders for Channeled and Flat Plate Work

Wales Punch and Die Holders

A new model Wales punch and die holder designed to punch three holes per unit has been brought out by the Strippit Corporation, 1200 Niagara St., Buffalo, N. Y. These self-contained die-holders are adapted for punching accurately spaced holes for riveting small parts to channeled or flat material. A series of three holes can be punched in a straight line or at any angle, according to the set-up of the holder on the rails or T-slotted plates.

The punch units are not attached to the ram of the press. The punch

To obtain additional information on equipment described on this page, see lower part of page 212.

and die members, being built into the holder, maintain accurate alignment for the life of the unit. Die-setting time is reduced by the use of these holders, since it is only necessary to lock the holders in position on the rail or T-slotted plate to make them ready for the punching operation. 82

Gulf Quenching Oil

A new quenching oil, known as Gulf Super-Quench, has been developed by the Gulf Oil Corporation, 3800 Gulf Bldg., Pittsburgh, Pa. One of the characteristics of this oil is a very fast cooling rate, which is stated to be intermediate between oil and water in the hardening temperature range; but it retains the slow rate of quenching action of oil below the hardening temperature range. It is claimed that this oil makes it possible to obtain the maximum in physical properties without any greater distortion than is caused by regular quenching oils. The oil was developed through extensive research, and its qualities have been proved by use in the field on many types and shapes of steel. 83

* * *

Converted Lathe Serves as Single-Purpose Horizontal Boring Mill

Conserving machine hours, using standard machines to replace the more critical types of machines for certain operations, and performing work on low-priced machines that is normally handled on higher-priced units, are all important factors in our armament program. The production boring mill operation performed on a Reed-Prentice 20-inch lathe in a Canadian plant, as shown in the accompanying illustration, is an outstanding example of such achievements. This work would normally require a horizontal boring mill valued at approximately $12,000. The job was satisfactorily performed on the 20-inch lathe costing approximately $5000.

This lathe, converted to serve as a single-purpose boring mill, drills, bores, under-cuts, and finishes the actuating shaft hole in an anti-tank gun breech ring. The material machined is nickel-chromium-molybdenum steel of about 275 Brinell hardness. The tailstock and compound rest have been removed from the lathe. The bed is supported by a center post. Hollow drills are used for this work, which permits feeding the lubricant through the center of the drill.

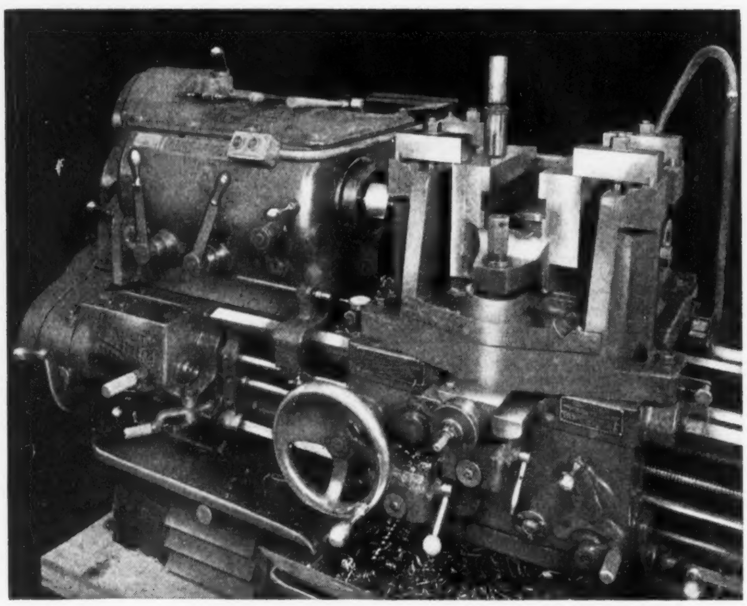
Spot-Welding Guns Used in Balancing

The dynamic balancing of rotating parts by the addition of balancing lugs instead of by removing metal is being accomplished by means of welding gun equipment developed for use with balancing machines by the Progressive Welder Co., Detroit, Mich. This method of balancing eliminates the necessity for leaving excess stock for the "balance machining" operations. The welding gun illustrated is fitted with a bracket which hooks over the ring gear of a hydraulic coupling. The gun is swung over the work for spot-welding a balancing lug of the required weight to the housing of the unit to be balanced.

Another type of welding gun (not shown) developed as an attachment for balancing machines is moved into the spot-welding position by an air cylinder. Both guns are hydraulically operated.

* * *

According to the National Machine Tool Builders' Association, machine tool shipments for January, this year, amounted to $85,200,000. The output in January a year ago was estimated at $50,700,000. The production in January this year was at an annual rate of over $1,000,000,000 a year.



Reed-Prentice Lathe Equipped to Handle Single-purpose Boring Mill Work

Welding Gun Used to Spot-weld Balancing Lugs

To obtain additional information on equipment described on this page, see lower part of page 212.

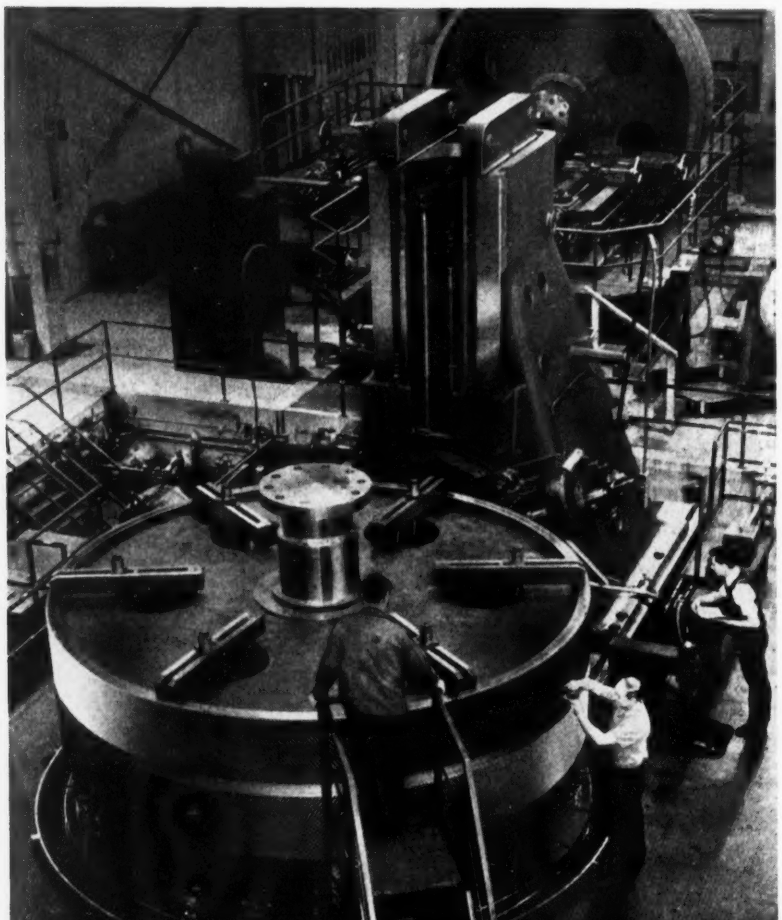
New Motion Picture Films for Training War Workers

A colored motion picture entitled "Inside of Arc Welding" has been produced by the Raphael G. Wolff Studios. This film is now ready for release to schools and training groups after six months of preparation. It is designed to speed up the training of thousands of men required in the welding of ships, planes, tanks, and other armament. Owing to the intense light created in arc welding, the filming of the subject was accomplished with great difficulty, but by the application of new lighting methods, it was found possible to depict the entire welding process. It has previously been thought to be impossible to picture the operation of the electric arc, since it is one of the most brilliant light sources known, and it is believed that this is the first time that the process has been clearly filmed in detail. Those interested can obtain complete information from the Raphael G. Wolff Studios, 1714 N. Wilton Place, Hollywood, Calif.

Eight reels applicable to training for war material production have been completed by the Emerson Yorke Studio for the U. S. Office of Education. The films, recording essentials in machine shop practice, were taken in war materials plants in the East. Three films cover operations on the shaper and two on radial drilling machines. Those interested in these films should communicate with the United States Office of Education, Washington, D. C., or the Emerson Yorke Studio, 130 W. 46th St., New York City.

* * *

The American Gear Manufacturers Association reports that industrial gear sales for February, 1942, were close to 35 per cent above February, 1941, and 22.5 per cent above January, this year. This applies to industrial gears only, and does not include automotive and turbine-drive gears.



A 200-inch gear-hobbing machine weighing more than 275 tons, built by the General Electric Co. for its own use in cutting low-speed gears for cargo ship propulsion sets. Ordinarily, eighteen months is required to build one of these machines; but by employing twelve sub-contractors in five states to complete the larger parts, and by parcelling out the smaller parts to thirty-eight firms in seven states, the work was completed in half that time. Such extensive subcontracting is especially interesting in view of the precision with which the machine must operate, since bull gears cut on the machine are finished to a tolerance in certain dimensions of 0.0003 inch

Increasing Application of Stainless-Clad Steel

Stainless-clad steel is likely to be extensively used during the present emergency as a substitute for solid stainless steel. The relatively thin layer of stainless steel that is used in the clad product saves a considerable amount of this valuable material and yet produces the required corrosion resistance. At the same time, it has the advantage of lower cost, compared with solid stainless steel. The Jessop Steel Co., Washington, Pa., maker of Silver-Ply stainless-clad steel, also calls attention to the fact that this material possesses the non-tarnishing and corrosion-resisting properties of brass sheets that have been used for many purposes where corrosion resistance was required.

* * *

Combination Calendar and Primer on Shop Practice

Continental Machines, Inc., Minneapolis, Minn., has brought out for 1942, the same as last year, a combination calendar and educational course on the fundamentals of machine shop practice. On each sheet of the calendar there is a lesson on metal-working. The calendar begins with the month of March, 1942, the last sheet being that for February, 1943. It will be sent free of charge by Continental Machines, Inc.


ZINC IN WAR
16 FUZE PLUGS EVERY 12 SECONDS!
Any fabrication process which is capable of turning out 16 semi-finished metal parts every 12 seconds is geared to war production. That is why the die casting industry is now taking on the production of direct and indirect implements of war. That is why zinc alloy must be available in sufficient quantities to enable the die casting industry to make an all-out war effort.
Zinc alloy is the most widely used metal in die casting because, with the selection of the most appropriate alloy, it enables the production of castings having four outstanding characteristics: Accuracy—close tolerances can be achieved and maintained throughout the useful life of a casting; Complexity—intricate shapes are obtained to incorporate many features in a single part, thereby eliminating much machining and assembling; Strength—zinc alloy die castings have higher shock resistance than most other cast materials; Economy—all of the foregoing factors, plus long die life and low metal cost, add up to impressive production economies.
The die casting industry is doing a war production job (as typified by the shell fuze plugs shown in the background) and the zinc is there as needed. But this represents one more reason why it will be difficult for civilian users to obtain all of the zinc they would like to use.
THE NEW JERSEY ZINC COMPANY
MANUFACTURERS OF THE FAMOUS HORSE HEAD ZINC PRODUCTS
6 DIE CASTING
METAL SPRAYING
GALVANIZING
PHARMACEUTICALS
NICKEL SILVER
1 HULL PLATES
2 RUBBER
3 PAINT
4 BRASS
5 CERAMICS
New Jersey Zinc
THESE FUZE PLUGS USED ON SHELL NOSES

Kropp Forge Co. Receives Navy "E" Award

On February 28, the Kropp Forge Co., 5301 W. Roosevelt Road, Chicago, Ill., was formally presented with the Navy Bureau of Ordnance "E" award. Before an audience of 2500 employes and their families and guests, Rear Admiral John Downes, commanding officer of the Ninth Naval District, placed the flags indicating "outstanding efficiency in the production of ordnance material" in the hands of Roy A. Kropp, president of the company.

In his presentation speech, Admiral Downes called attention to the fact that uniforms had lost most of their significance in this war—that diemakers, machinists, welders, and scores of other classes of workers had become vital factors in achieving victory. He said, "It is not improbable that major battles—unknown and unsung—will be fought out in the machine shops, shipyards, and engineering laboratories." He went on to say that it was possible for the United States to lose this war through negligence, through slowdown of production, and by wishful thinking taking the place of hard work.

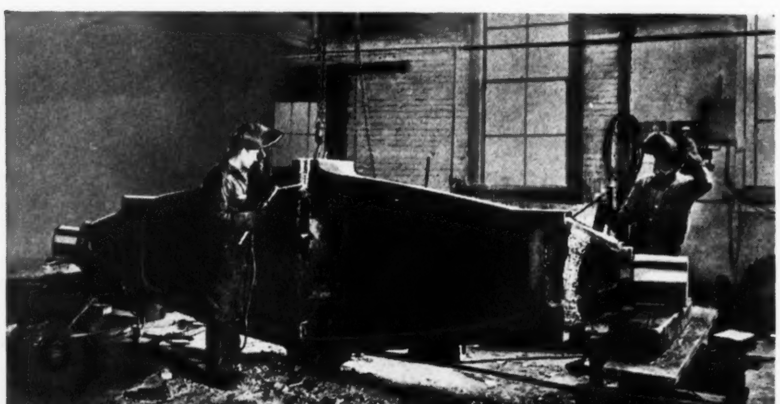
Mr. Kropp responded to the admiral's address with a brief statement, in which he praised the company's employes for their loyalty and tireless efforts for the success of the war production program.

Welded Test Jack Used in Making Bending Tests on Welds

Repairing a Heavy Cast-Steel Cross-Head by Arc Welding

One of the advantages of electric arc welding is its adaptability for welding extremely large as well as very small work. Recently a 13,000-pound cast-steel cross-head from a blast furnace blower engine in a Buffalo, N. Y., plant was cracked at two points, one end being broken completely off. To manufacture and ship a replacement part of this size—14 by 5 feet—would have meant a long shut-down of the unit, with a heavy loss. Repairs by welding at first seemed impractical, due to the large size of the broken unit. However, this impression proved erroneous.

After careful preparation and lining up, and about fifty hours of actual welding time, the mechanics of the Hebelar Welding Co., Buffalo, N. Y., had the broken end section firmly welded in its proper place. In approximately another fifty hours, the cracked hub was repaired with a welding seam that is just as strong as the original parent metal. Several hundred pounds of "FR" electrodes, made by the Harnischfeger Corporation, Milwaukee, Wis., were used on the job. Since the unit has been back in service, there has been no indication of its ever having been damaged, except for the welding seams, which serve as reminders of the time and dollars saved by the use of the arc-welding process.



Arc-welding Cracks in Cast-steel Engine Cross-head Weighing 13,000 Pounds

Welded Test Jack for Testing Welded Parts

The training of hundreds of new welding operators throughout the country to meet the war demands has made it necessary to find means for testing the work of new welders faster than before. To speed the testing of welds, the instructors at the B. H. Leonard Welding School, St. Louis, Mo., and engineers from the Midwest Piping & Supply Co., of the same city, designed the all-welded test jack shown in the illustration.

The device consists of a sturdy frame built around a hand-operated hydraulic jack. It is used for making bending tests on welded samples, and is valuable in checking the ability and reliability of arc-welding operators. The device is welded with Lincoln equipment from scrap pieces of steel.

* * *

Lincoln Award Reminder

The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, wishes to remind all those intending to participate in the Progress Award Program conducted by the Foundation that their competing papers must be postmarked not later than June 1 to qualify for an award. As previously announced, this award program relating to arc welding progress includes 458 awards totaling $200,000.

NEWS OF THE INDUSTRY

California

INTERAIRCRAFT MACHINE SHOP, INC., 3851 Medford St., Los Angeles, Calif., engaged in sub-contract work for aircraft builders, has taken over the manufacture and sale of Hydra-Grip, a recently developed hydraulic work-holder for gang-chucking operations. The Hydra-Grip holds ten pieces of work, by interchangeable collets, in accurate alignment for precision machining on milling machines, shapers, grinders, or drilling machines.

FRAY MACHINE TOOL CO., Glendale, Calif., has appointed the DOUGLAS MACHINERY CO., 150 Broadway, New York City, exclusive sales agent for all of New England and the Atlantic Seaboard except Pennsylvania, with the territory extending west to the Mississippi River, not including the states of Illinois, Ohio, and Michigan.

Illinois

INDEPENDENT PNEUMATIC TOOL CO., with headquarters at 600 W. Jackson Blvd., Chicago, Ill., announces the removal of the company's Detroit branch to its own new building at 15605 Woodrow Wilson Ave. The company has also recently expanded its factory production facilities with new additions in space and equipment at both its Los Angeles, Calif., and Aurora, Ill., plants.

MANUFACTURERS SCREW PRODUCTS, 212-222 W. Hubbard St., Chicago, Ill., have acquired 15,000 extra square feet of floor space and installed additional screw manufacturing equipment which has been in production since early in March. These added facilities were necessary to enable the company to handle its constantly increasing volume of business.

BENNETT BURGOON, JR., formerly mechanical engineer in the Railway Steel Spring Division of the American Locomotive Co., is now district representative in western Illinois and Iowa for the McKenna Metals Co., Latrobe, Pa., with offices at 917 Talcott Bldg., Rockford, Ill. Mr. Burgoon graduated from the College of Engineering, University of Illinois, in 1932.

ACOUSTIC DIVISION OF THE BURGESS BATTERY CO. is now located at 2815 W. Roscoe St., Chicago, Ill. This division makes noise preventing devices for Diesel engines, etc.

Massachusetts

WILLIAM S. HOWE has retired as president and treasurer of the Production Machine Co., Greenfield, Mass., of which he has been at the head since its organization twenty-five years ago. In 1917, under his direction, the business of J. C. Blevney Co., Newark, N. J., was purchased and brought to Greenfield. The company was established for the manufacture of patented polishing machinery. Later, other lines were purchased and added, so that the company is now manufacturing, in addition to polishing machines, Peerless abrasive surfacers, Reed sensitive drills, hand screw machines, and Greenfield tool and cutter grinders. Mr. Howe will continue to operate Howe & Son, Hinsdale, N. H., of which he is the owner. This company manufactures automatic saw sharpeners for hacksaws, band saws, metal-slitting saws, etc.; tool and cutter grinders; and twist drill grinders.

JOSEPH T. WRIGHT has been appointed manager of the Compressor and Tool Division of the Holyoke, Mass., Works of the Worthington Pump & Machinery Corporation. Mr. Wright at one time was assistant works manager of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Later he organized the J. T. Wright Co. for the manufacture of paper drilling machines and other special equipment. This organization was subsequently merged with the Harris-Seybold-Potter Co., Dayton, Ohio which company Mr. Wright served in several capacities.

New Jersey

HENRY C. BEAL, formerly works manager of the Western Electric Co.'s Kearney, N. J., Works, has become engineer of manufacture, with offices at the company's headquarters, 195 Broadway, New York City. He will be succeeded as works manager by REESE F. CLIFFORD, personnel director for the last year. ARTHUR B. GOETZE, assistant personnel director, will assume Mr. Clifford's post.

BARNARD S. MEADE has been appointed sales representative of the American Swiss File & Tool Co., Elizabeth, N. J. For the last five years he has been field representative for the Vise Division of the Charles Parker Co., Meriden, Conn. His headquarters will be at the home office in Elizabeth.

New York

J. H. WILLIAMS & CO., of New York City and Buffalo, N. Y., manufacturers of drop-forgings and drop-forged tools, at a recent meeting of the board of directors elected A. DONNALLY ARMITAGE president to fill the vacancy caused by the recent death of J. Harvey Williams. E. J. WILCOX was elected vice-president in charge of stock products sales; WILLARD C. KRESS, vice-president in charge of all manufacturing; HUGH AIKMAN, secretary; and CLARK M. FLEMING, treasurer.

EDWARDS CO., Sanford, N. C., manufacturer of self-propelled railway passenger motor cars, has purchased the HILL DIESEL ENGINE CO., Lansing, Mich. Both companies maintain executive offices at 724 Garrison Ave., New York City. RALPH B. ROGERS, president of the Edwards Co., will head the new Hill management; R. E. OLDS, who has had an active part in the development of the automobile industry, is chairman of the board of directors.

RUSSELL CREIGHTON, who has been in charge of production engineering for the Bell Aircraft Corporation, Buffalo, N. Y., has been made special assistant to the works manager, LESTER L. BENSON. JOSEPH B. BAUER will succeed Mr. Creighton in charge of production engineering. HARRY W. ASHBURN, previously in charge of tool design, has been appointed chief planning engineer, and HAROLD L. SMELTZER will succeed Mr. Ashburn.

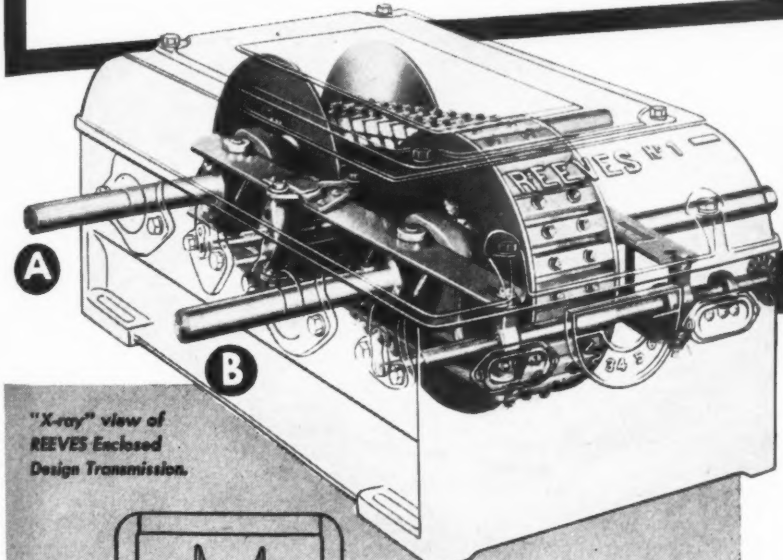
Ohio

LINCOLN ELECTRIC CO., Cleveland, Ohio, announces the following new addresses for some of its branch offices: Oklahoma City, Okla., 19 N. Ellison St.; Milwaukee, Wis., 733 N. Van Buren St.; Chattanooga, Tenn., 1111 James Bldg.; Chicago, Ill., 323-325 E. 23rd St.; Omaha, Neb., 521 S. 15th St.; and Dayton, Ohio, 246 Wiltshire Blvd.

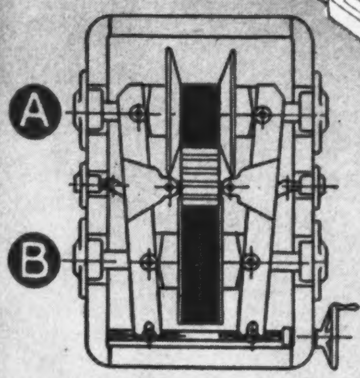
NOBLE B. CLARK, manager of sub-contracting for the Warner & Swasey Co., Cleveland, Ohio, has been made assistant sales manager. FRANK J. PELICH, district manager at Milwaukee, will succeed Mr. Clark as manager of sub-contracting. GEORGE L. KLUTER, assistant to the vice-president, has been promoted to the position of works engineer.

PAUL KELLER has been appointed manager of tool, stainless, and special steel sales for the Copperweld Steel Co., Warren, Ohio. Mr. Keller is a graduate of the University of Ten-

See HOW THE REEVES TRANSMISSION PROVIDES COMPLETE SPEED ADJUSTABILITY . . .

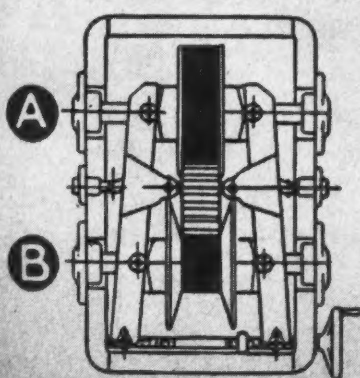


"X-ray" view of REEVES Enclosed Design Transmission.



AT MINIMUM SPEED POSITION

On constant speed shaft "A," cone-faced discs and speed-changing levers are *farthest apart* while the V-belt runs at *smallest* diameter between the discs. On variable speed shaft "B" reverse is true and shaft runs at *minimum* speeds.



AT MAXIMUM SPEED POSITION

On constant speed shaft "A," cone-faced discs and speed-changing levers are *closest together* while the V-belt runs at *largest* diameter of the discs. On variable speed shaft "B" conditions are reversed and this shaft runs at *maximum* speed.

The entire speed range is covered smoothly, without steps or jumps, from one speed to another and while the driven machine is in operation. No interrupting production.

"One of the best investments we ever made. Your drives have been in operation on our machines for years with negligible maintenance expense," says a Cleveland manufacturer.*

You can quickly see by these diagrams how the Reeves Variable Speed Transmission provides any driven machine with infinite speed adjustability.

Design is based on the proved and tested principle of a V-belt driving between two pairs of adjustable cone-faced discs mounted on parallel shafts. One shaft receives power at constant speed from motor, lineshaft, etc. The other, connected to the driven machine, transmits power at infinitely adjustable speeds above and below the speed of the constant speed shaft as the V-belt assumes different diameters of contacts against each set of discs.

Power is transmitted positively because of non-slipping, wedge-like action of the rugged Reeves endless cord V-belt. Equally important—any speed setting is maintained without fluctuation because *belt tension is automatically controlled at all driving diameters.* With Reeves speed adjustability, positive and accurate over full range, machines can be run at greatest efficiency under every changing condition.

Sizes from fractional to 87 h.p. Speed ratios from 2:1 through 16:1. Vertical and horizontal models. Manual, automatic or electric remote controls for speed changing. Write us.

REEVES PULLEY CO., ***Dept. M,*** **COLUMBUS, IND.**

* Name on request.

REEVES *Accurate Variable* Speed Control

nessee, and was formerly manager of the Cleveland sales district of the company.

Pennsylvania and Virginia

JOHN WILSON has been appointed production superintendent of the Jessop Steel Co., Washington, Pa. Mr. Wilson became connected with the Jessop organization in 1911, and in 1931 was made superintendent of the sheet mill department.

John Wilson, New Production Superintendent of the Jessop Steel Co.

WALTER LARKIN, for many years inventor with the Fidelity Machine Co., Philadelphia, Pa., has been awarded a certificate of merit by the board of managers of the Franklin Institute "in consideration of his admirable machine designing, involving the ingenious application of known mechanical movements to the invention of circular knitting machines of special types." Mr. Larkin is well known in the textile industry, especially in the seamless knitting field. He has a total of twenty-seven inventions to his credit for which he has been awarded patents in this and foreign countries.

FRENCH E. DENNISON, formerly of the Small Commercial Refrigeration Development Department of the York Ice Machinery Corporation, York, Pa., has been called by the War Department to serve as chief inspector in the Philadelphia Ordnance District. During the first World War, Mr. Dennison served with the Ordnance Department at the Rock Island Arsenal.

J. D. WOOD has resigned as president of the Roller-Smith Co., Bethlehem, Pa., in order to devote his entire time to his duties as chief engineer. REG HALLADAY has been elected to fill the position of president. F. A. JUDSON, who joined the company in September, 1941, as general manager, was elected treasurer.

SAYRE M. RAMSDELL ASSOCIATES, INC., 3701 N. Broad St., Philadelphia, Pa., has been organized to take care of the advertising for a selected group of industrial companies. The president of the new agency is Sayre M. Ramsdell, who has had charge of advertising and sales promotion for the Philco Corporation since 1922. Mr. Ramsdell will continue to serve as a member of the board of directors of the Philco Corporation.

T. A. LYNCH, sales manager for the aeronautical industry for the Reynolds Metals Co., Inc., Richmond, Va., has been elected a vice-president of the corporation.

Texas

ROBINSON S. KERSH has been appointed manager of the Houston, Tex., office of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Kersh has been with the Westinghouse organization since 1929, having served in various capacities. He graduated from the Mississippi State College in 1929 with a degree in electrical engineering.

Wisconsin and Michigan

EDWIN H. BROWN has been elected vice-president of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., in charge of engineering and development. Mr. Brown has been manager and chief engineer of the company's engine and condenser department for seven years. He is a graduate of the University of Nebraska, class of 1906, and has been with the Allis-Chalmers organization since his graduation.

Edwin H. Brown, Vice-president in Charge of Engineering and Development with the Allis-Chalmers Mfg. Co.

GISHOLT MACHINE CO., Madison, Wis., manufacturer of turret and automatic lathes and static and dynamic balancing machines, has made a substantial addition to its turret lathe manufacturing facilities. The new building is a one-story addition to the company's Northern Works, reopened a year ago. It covers approximately 50,000 square feet.

RALPH R. NEWQUIST has been appointed assistant to Walter Geist, vice-president of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. He is a graduate in electrical engineering of the Pennsylvania State College.

C. A. CHENEY has been appointed Detroit district sales manager of the Cleveland Automatic Machine Co., Cleveland, Ohio. Mr. Cheney will have headquarters at 2842 Grand Blvd., Detroit. He was formerly with the General Machinery Corporation, Hamilton, Ohio.

L. J. HAGA has been appointed chief metallurgist of the Kaydon Engineering Corporation, Muskegon, Mich.

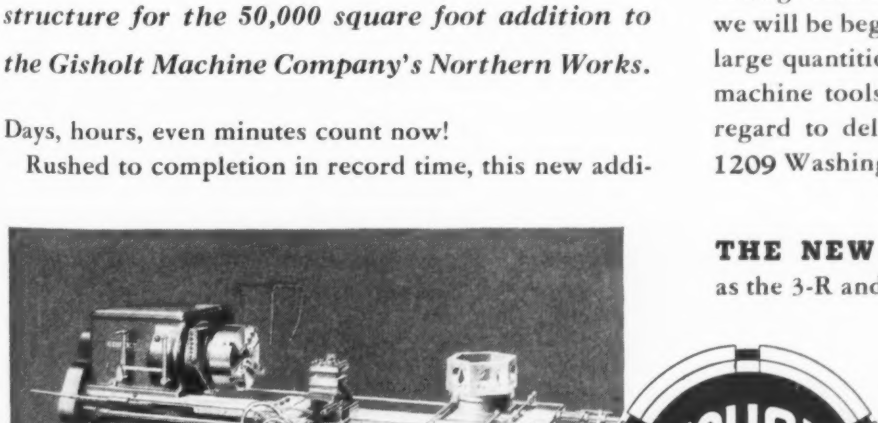
* * *

Motors and Controls Selected with "Slide-Rule"

A pocket-size "slide-rule," known as Electric Drive Selector SA-714, for electricians, plant maintenance men, and others interested in the selection of electric drive equipment has been announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

To guide in the selection of the proper type of motor for forty-four industrial applications, a convenient table lists the various uses and indicates which of the four principal types of alternating-current motor should be selected. The specifications, performance ratings, and control classes for the required type are readily determined by the slide.

Information is obtained from the selector by setting the cardboard slide for the proper motor type and then reading its specifications through the window in an acetate envelope. Horsepower ratings, speeds, voltages, frequencies, and starting and pull-out torques, are thus determined. The reverse side of the selector shows which of the various magnetic and manual controls are available for each type of motor, and lists the control number.



GISHOLT

OBITUARIES

Henry M. Lucas

Henry M. Lucas, president and treasurer of the Lucas Machine Tool Co., Cleveland, Ohio, died Monday, March 2, from a heart ailment at the age of seventy-three years. Mr. Lucas was born in Cleveland in 1869, and lived in that city all his life. He started as a machinist apprentice with the Warner & Swasey Co. in 1886. Later he became department foreman, meanwhile studying engineering at night. Soon afterward, he had an opportunity to enter the engineering department of the Warner & Swasey Co., and in 1893 he erected the Yerkes telescope at the Chicago World's Fair for that company. He became chief draftsman in 1895, and while in that position supervised the installation of astronomical instruments in the Naval Observatory at Washington.

In 1899, Mr. Lucas left the Warner & Swasey Co., and on January 1, 1900, he organized the Lucas Machine Tool Co., with his brother, the late George C. Lucas, and the late Frank Yost, as partners. At that time, he designed and built his first horizontal boring, drilling, and milling machine, which has been identified with his name throughout the world.

Mr. Lucas was a member of the National Machine Tool Builders' Association, and served as its president in 1926. He is survived by his wife, Mabel Corinne Lucas, and a son and daughter by a former marriage, Henry D. Lucas and Mrs. Thomas B. Fulmer, Jr.

J. Harvey Williams

J. Harvey Williams, president of J. H. Williams & Co., New York City and Buffalo, manufacturers of drop-forgings and drop-forged tools, died in a New York City hospital on February 23 due to a heart attack resulting from shock following an operation performed a few weeks previously. He would have been sixty years old in another month.

Mr. Williams was born in Brooklyn, N. Y., in 1882. He was the eldest son of James H. Williams, founder of J. H. Williams & Co. Following the death of his father in 1904, he became vice-president of the company, and in 1916 president, which office he held until his death. In 1923, when the Brooklyn plant was closed and its facilities consolidated with the present Buffalo Works, he moved to Buffalo; but in 1930, at the time that the company's general offices were established in New York City, he returned to New York.

Mr. Williams was a graduate of Yale University. He took an active part in civic affairs in Brooklyn, and was president of the Chamber of Commerce in 1921. He was one of the founders of the American Drop Forging Institute, and served as president of the American Supply & Machinery Manufacturers' Association. He was also a director of the New York State Economics Council. He contributed numerous articles to business magazines and published two treatises dealing with the Sherman and Clayton Acts.

J. Harvey Williams

Mr. Williams is survived by his widow, Jennet D. (Blackwell) Williams, by two sons—James Harvey 3rd and Blackwell Williams—and by his sister, Miss Frances Williams.

COMING EVENTS

APRIL 6-7—MACHINE TOOL FORUM at the East Pittsburgh Works of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

APRIL 9-10—Annual meeting of the MIDWEST POWER CONFERENCE at the Palmer House, Chicago, Ill. For further information, address Alexander Schreiber, Illinois Institute of Technology, Chicago, Ill.

APRIL 20-21—Meeting of the Galvanizers Committee of the AMERICAN ZINC INSTITUTE, INC., at the Hotel Chase, St. Louis, Mo. For further information, address the American Zinc Institute, Inc., 60 E. 42nd St., New York City.

APRIL 20-24—Forty-sixth annual convention of the AMERICAN FOUNDRYMEN'S ASSOCIATION in Cleveland, Ohio. For further information, address American Foundrymen's Association, 222 W. Adams St., Chicago, Ill.

MAY 11-13 — Twenty-sixth annual convention of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at Hotel Hershey, Hershey, Pa. J. C. McQuiston, manager-secretary, 602 Shields Bldg., Wilkinsburg, Pa.

MAY 31-JUNE 5—Semi-annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Greenbrier Hotel, White Sulphur Springs, W. Va. John A. C. Warner, secretary, 29 W. 39th St., New York City.

JUNE 8-10—Semi-annual meeting of AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Cleveland, Ohio. Secretary, C. E. Davies, 29 W. 39th St., New York City.

JUNE 22-26—Forty-fifth annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary-treasurer, 260 S. Broad St., Philadelphia, Pa.

OCTOBER 12-16 — NATIONAL METAL CONGRESS AND EXPOSITION in Detroit, Mich., sponsored by the American Society for Metals. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland.

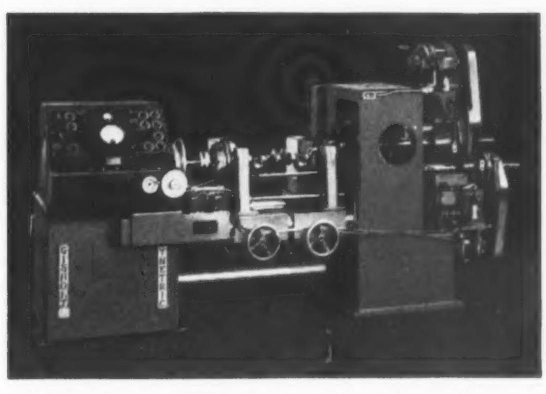
NOVEMBER 17-22—NATIONAL CHEMICAL EXPOSITION and INDUSTRIAL CHEMICAL CONFERENCE at the Stevens Hotel, Chicago, Ill. For further information, address National Chemical Exposition, 110 N. Franklin St., Chicago, Ill.

"Tune-In" ON trouble ... BEFORE IT HAPPENS!

DYNETRIC BALANCING MACHINES

Those faint, almost imperceptible "throbs" are the telltale evidence of destructive forces that will attack any high speed rotating part. But they can't hide from this super-sensitive machine which detects unbalance vibrations as small as .000025". It picks up these danger signals, amplifies them. And in a few seconds, unbalance is located and measured, permitting quick and simple correction to eliminate the hazard of vibration, noise and excessive wear.

Now that accurate balancing has been made so simple and economical to attain, through the use of Gisholt Dynetric Balancing Machines, hundreds of motor-driven products will benefit through smoother, quieter, and more efficient operation. If you use high speed rotating parts in your products, it will pay you to investigate.



Gisholt Balancing Machines are built in various sizes and types to answer practically all requirements. Their operation is discussed in an interesting new bulletin, profusely illustrated. Your copy will be sent on request.

Look Ahead . . . Keep Ahead . . .
With Gisholt Improvements

GISHOLT

GISHOLT MACHINE COMPANY • 1209 E. Washington Ave., Madison, Wis.

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES

NEW BOOKS AND PUBLICATIONS

FLIGHT (AVIATION ENGINES). By Ray F. Kuns. 363 pages, 6 by 9 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price, $3.25.

This book on aviation engines is a revision of material formerly published by the Junior Air Service of America, Inc., in book and unit lesson form. The basic idea of the book has not been changed, but the text has been brought up to date and a great deal of new material has been added. The book is intended for the layman and beginner, and is suitable for use in teaching aviation in schools. It describes in simple terms the construction and operation of aircraft engines, starting with the elementary types. At the end of the book there is a list of quiz questions covering the different sections, intended to assist the reader or student in testing his knowledge.

MACHINE SHOP THEORY AND PRACTICE. By Albert M. Wagener and Harlan R. Arthur. 306 pages, 8 1/2 by 11 inches. Published by the D. Van Nostrand Co., Inc., 250 Fourth Ave., New York City. Price: Cloth-bound, $2.28; paper-bound, $1.60.

This text book has been written to meet the needs of beginners in the study of machine tools and their operation. It is intended for apprentices in the tool and die making, machinist, and allied trades. The introductory chapters acquaint the student with the commonly used precision and semi-precision tools. Then follow chapters on the various types of machine tools, beginning with the simple ones and continuing through the more complicated ones. The closing chapters describe the use of bench tools and small hand tools. Standard operations on each of the various machines are described at some length.

SUB-CONTRACTING FOR DEFENSE. 68 pages, 8 1/2 by 11 inches. Published by the Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York City.

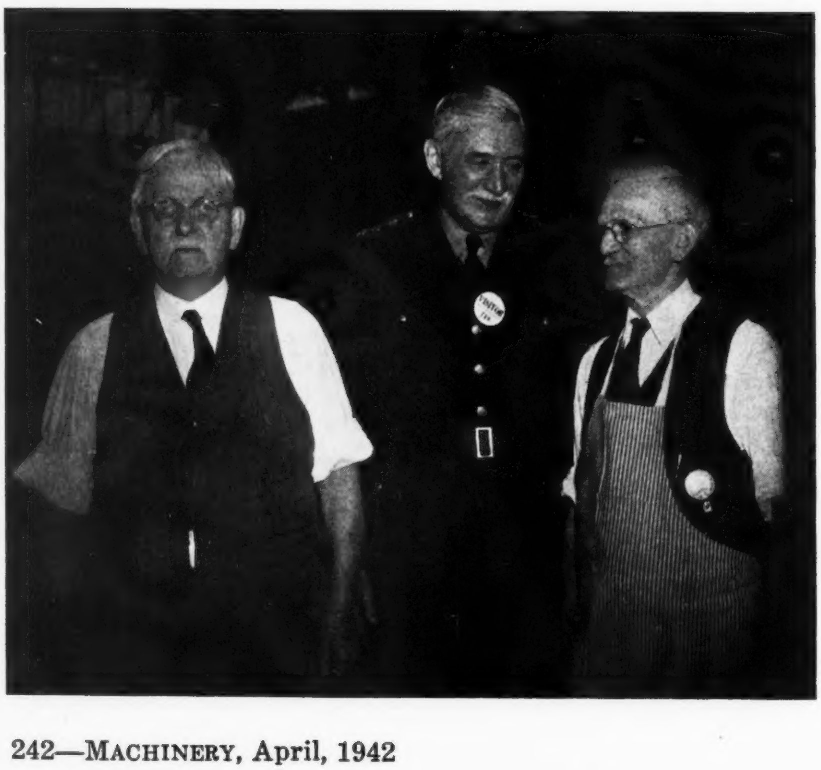
This investigation and study relating to sub-contracting in war production has been prepared in the interest of stabilizing employment. The treatise presents an outline of the methods by which the problems met with in both primary contracting and sub-contracting have been solved. It is based on the practices of twenty-eight companies, including concerns who have been outstandingly successful in their respective fields. Copies are available upon application to the Metropolitan Life Insurance Co., New York City.

RUNNING A MILLING MACHINE. By Fred H. Colvin. 157 pages, 4 3/4 by 7 1/2 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price, $1.50.

The milling machine is used in so many operations in nearly every machine shop that anyone intending to work in a shop should become familiar with the principles and methods of its operation. It is the purpose of this little book to provide the beginner with a working knowledge of milling machines and how they are used. It covers the different kinds of milling machines; the kind of work each does; how to operate the various types of machines; what cutters to use; and the proper speeds and feeds, etc.

BLUEPRINT READING. By D. E. Hobart. 105 pages, 8 1/4 by 10 3/4 inches. Published by Harper & Bros., 49 E. 33rd St., New York City. Price, $1.

This book on blueprint reading is based on the author's experience in teaching the reading of machine drawings at General Motors Institute, where men taking courses in machine shop practice were required to work from drawings in the machining of their practice exercises. In addition to general instruction in blueprint and drawing reading, many problem drawings are included, so that the student can test his knowledge.



Henry Stevenson (Left) and William Hansen (Right), with the Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., for over Fifty Years Each, Photographed with Lieutenant General William Knudsen on the Occasion of a Visit that He Recently Made to the Pratt & Whitney Works